IMITATIVE BEHAVIOR AS A JOINT FUNCTION OF RATE OF REINFORCEMENT AND THE PRESSURE TO IMITATE

By

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CHAPTER I

INTRODUCTION

The acquisition and extinction of imitative behavior can be viewed as being determined by the same conditions of learning which influence other behavior. Such a position is argued by Newcomb (1950) in most unequivocal terms. He states:

> . . . imitation presupposes learning. . . . Imitation, in fact, is subject to the same range of conditions which are known to determine the many variations of learned behavior. People imitate or do not imitate, depending upon what they have learned, are capable of learning and are motivated to learn. (p. 11)

History

From the point of view of learning theory, the most extensive exposition of imitation is that by Miller and Dollard (1941). Their expressed intent was to present a model for the learning of imitative behavior based on reinforcement theory. They went on to develop a Hullian model based on reinforcement through the mechanism of drive reduction.

They distinguish three levels of imitation, each successive level involving increasingly complex behavior on the part of the imitator. It is the second level, matched-dependent behavior, which they treat more elaborately, both in theoretical analysis and experimental verification, and which is most pertinent here.

Briefly stated, the model identifies four aspects of the situation as necessary to the occurrence of imitation learning - drive, cue, response, and reward. A paradigmatic representation of the model is given in Figure 1.

	Leader		Imitator
Drive	Hunger		Hunger
Cue	Discriminable Stimulus	dependent	Leader's approach of goal
Response	Approaches goal	matched	Follows leader
Reward	Food		Food

Figure 1. Paradigm of matched-dependent behavior. (After Miller & Dollard, 1941.)

The imitator's behavior differs from the leader's in that the environmental cue to which the latter responds is not accessible to the imitator. Instead, the cue to which the imitator responds is the behavior that the leader exhibits. A similar analysis holds for the establishment of responses of non-imitation. The rewarded response is, in that case, not-following the leader.

Translated into experimental manipulations, a hungry imitator rat is placed in a T-maze behind a leader rat previously trained to choose one arm of the maze. The imitator is rewarded with food if he follows the leader - i.e., selects the same arm of the maze. Leaders trained to opposite arms of the maze are alternated in a random sequence

on successive trials. To the extent that the imitator rats reliably come to follow the leader, imitation is said to have been learned.

Since the method by which the leaders are induced to select the appropriate response is not relevant to the imitation paradigm, a typical procedure with human subjects (Ss) is to instruct the leader to make the responses to be imitated in some predetermined sequence which the imitator cannot predict (e.g., Miller & Dollard, 1941; Luchins, 1944). An alternative method is to designate the leader's (or, sometimes the presumed leader's) responses correct in some predetermined random order (e.g., Schein, 1954; Rosenbaum & Tucker, 1962).

Miller and Dollard support their analysis of imitative behavior as an instance of instrumental conditioning by their findings in a series of experiments with rats and children. They demonstrate that there is no "instinct" to imitate but rather that imitation is acquired behavior which is strengthened by reinforced practice; that stimulus generalization and, to a lesser extent, response generalization occur when changes are made in the leader or response for which training was given; that imitation trained with one drive (hunger) transfers to a second drive (thirst); and that training is effective in establishing a "prestige" (adult vs. child) discrimination. In short, the principles governing other learned behavior can be seen to operate in imitative behavior.

In extending their formulation of the imitative behavior model to the realm of social behavior in general, Miller and Dollard invoke the mechanism of secondary reward to account for the large range of imitative behavior which is observed. Parental praise, approval of peers,

performing a correct response, all acquire secondary reinforcing properties by virtue of their previous repeated association with primary reward and drive reduction.

These reinforcers become established fairly early in life and continue as a pervasive force in social learning. Thus, the behavior of the older, the superordinate in social status, the more intelligent, and the superior in skill provides generalized cues for imitation, to the younger, the lower in social status, the less intelligent, and the inferior in skill. Imitation of socially desirable leaders comes to be a well ingrained habit maintained by secondary reinforcement as is the non-imitation of undesirable leaders.

Although no full repetition of the Miller and Dollard studies has been reported, several partial replications are to be found.

In a discussion of the Miller and Dollard model, Asch (1952) reports two unpublished experiments by Field. The first is an exact replication of the Miller and Dollard experiment in which children, working for a candy reward, learned to go to the same one of two boxes selected by a leader child whose choice was directed by a covert signal from the experimenter. The replicated experiment produced substantially the same results as found by Miller and Dollard. In the second experiment, candy reward was replaced by the reward of finding a ball which the child was not permitted to keep (a reward which appears to be analogous to being right). The results are again in accord with those of Miller and Dollard. Asch sees the second Field study as evidence against the hypothesis that imitation is mediated by drive and drive-reduction. However, viewing the reward as having secondary reinforcing

properties, the study lends support to Miller and Dollard's assertion that secondary reinforcement has a significant role in the development of imitative behavior.

A second partial replication of the Miller and Dollard study occurs in an experiment by Solomon and Coles (1954). After training hungry rats to imitate one set of leaders in a T-maze, they tested for transfer of imitation to other leaders avoiding shock in a shuttle-box. Results of the initial training period followed closely the findings of the similar Miller and Dollard experiment. However, the imitation-trained rats did no better in the shuttle-box than a previously trained control group. Solomon and Coles attribute their failure to demonstrate generalization of imitation to the fact that the test conditions differed from the training conditions in drive (fear vs. hunger), environment (shuttle-box vs. maze), response (jumping vs. running), and social stimulus (shuttle-box leaders vs. maze leaders). In effect, generalization would have had to occur across all these dimensions simultaneously.

Other studies have generally found only an equivocal relationship between reinforcement and imitation.

Luchins (1944) failed to produce imitation of judgments by some of his children _S_s. The task was to choose the shorter of two lines presented in pairs. The leader _S_ was instructed beforehand by the experimenter (_E_) to give correct or incorrect judgments under different conditions of the study. The imitator _S_ gave his judgment after the leader. In one condition, training was given with lines of equal length. The leader judged one line of each pair as shorter and was called right. The imitator was called right only if he agreed with the

leader. Twelve of the 20 imitator Ss continued to disagree with the leader up to the 30th trial, five disagreed up to the 45th trial, while one S failed to agree after 120 trials. In contrast, Miller and Dollard's children Ss learned to imitate after a mean of 3.1 trials.

In a study with adult Ss Schein (1954) reports slim evidence for the effectiveness of reward in inducing imitation. Five Ss at a time were required to match groups of letters and numbers as being similar by some presumed (but non-existent) system. Reinforcement, being called right, was contingent on agreement with the second S. The level of imitation reached by the experimental group after 20 reinforced trials was approximately 42 per cent as compared with 24 per cent for a control group. Tests for generalization of imitation to other tasks showed lower levels of imitation and, in one instance, a reversal between experimental and control groups.

Schein elaborates on a suggestion by Luchins (1944) that the low level of imitation observed may be due to the similarity of the experimental situation to previous experience with cheating. Since imitation in the form of cheating had in the past been associated with negative sanctions, it is likely to be suppressed in the experimental situation.

Probability learning

A frequently used setting for studying imitative behavior has been the "verbal conditioning" (Humphreys, 1939) or "probability expectancies" (Brunswik, 1939) paradigm. Briefly, the paradigm requires that S make a choice among two or more alternative responses delineated

by E. Under the non-contingent condition, S's response has a fixed probability of being rewarded by E regardless of what S's previous responses might have been. Under the contingent condition, the probability of reward is varied by E in some systematic way depending on S's previous responses.

A recurrent finding in studies using this paradigm has been the substantiation of the "matching hypothesis" proposed by Grant, Hornseth, and Hake (1951). They define matching behavior as the correspondence between the proportion of times that S chooses a given response, to the overall probability of that response being rewarded. Estes (1964) and Bush and Mosteller (1955), among others, have studied matching behavior extensively and have developed mathematical models which predict precisely the course of acquisition and the level of asymptotic responding to be expected under varying conditions.

Bush and Mosteller (1955) report an experiment on imitation by Shwartz with grade and high school students using the probability learning paradigm. Two Ss, one after the other, were to guess whether E was going to say "a" or "b" on each of 50 trials. For the experimental groups, E said whichever letter the first S said on 80 per cent of the trials. Thus, the second S would have been reinforced 80 per cent of the time if he imitated the first S each time. Control groups received 50 per cent reinforcement in the same way. With the grade school Ss, imitation under the 80 per cent reinforcement condition was significantly higher than under the 50 per cent reinforcement condition. However, the asymptote reached by the experimental group was about 60 per cent. With high school Ss, no significant difference between

experimental and control groups was found and neither of the control groups reached the 50 per cent level of imitation. From estimates of the model parameters, Bush and Mosteller conclude that events which inhibit imitation have a greater effect than events which increase it. Like Schein (1954) and Luchins (1944), Bush and Mosteller suggest social disapproval of copying as the reason for the inhibition of imitation.

In a direct test of the effect of the social consequences of imitation on the level of imitative behavior, Kanareff and Lanzetta (1958) and Lanzetta and Kanareff (1959) verified their prediction that inducing a negative set toward imitation by instruction tended to reduce the level of imitative responses. They used a pitch discrimination task in which identical tones were judged by each member of pairs of Ss after being given information about the purported judgment made by the "partner" S. Under different conditions, .20, .50, or .80 of the "partner's" proportion of judgments were designated correct. Reinforcement for the real Ss, being right, occurred if they agreed with the "partner" when the latter was "correct" and disagreed when the latter was "wrong". Groups receiving "negative" sanctioning instructions imitated less than groups given "neutral" instructions. The difference, however, was overcome by the introduction of a monetary reward. This finding suggests that the reinforcing effect of money is relatively stronger than the suppressive effect of negative sanctions.

A more significant outcome of these studies is the failure to find the probability matching predicted by Estes (1957) and Bush and Mosteller (1955). According to the matching "law," the expectation is that the cumulative proportions of a given response and the corresponding

reinforcing event will tend to equality - that is, that the proportion of correct responses will equal the probability of reinforcement of that response. Only in the .50 reinforcement condition did matching occur. In the .80 condition there was undermatching and in the .20 condition overmatching occurred.

A similar lack of correspondence between the rate of reinforcement of imitation and the level of imitative responses was found by Neimark and Rosenberg (1959). They varied event reinforcement probabilities (π) and imitation reinforcement probabilities (ρ) independently in a typical verbal conditioning situation. Three Ss at a time were to predict which of two lights would occur on each of 200 trials. Before each S made his predictions, one of a second pair of lights was turned on by E. This light correctly predicted the light that was to be guessed by S 1.00, .75, .50, .25, or 0 proportion of the time and constituted the different ρ values used in the experiment. For the π values, one of the lights which the Ss were to predict came on 1.00, .75, or .50 proportion of the time. For two-thirds of the Ss (social groups) the lights used to produce the ρ values were identified as the prediction of one of the other Ss. For the remaining Ss (non-social groups) they were identified as ready signals. Thus, in addition to various rates of reinforcement of a correct response, there were also varying rates of reinforcement for agreement with a discriminative "social" cue (imitation) or "non-social" cue.

The pertinent findings of this study were that the introduction of a discriminating predictive cue retards learning rate, especially if the cue is identified as originating from a social source - i.e., if it

is a cue to be imitated. More surprisingly, although the data for the "non-social" groups were well fitted by Estes-type curves based on ρ values, the response rates of the "social" groups for the identical ρ values departed radically from the predicted asymptotes. In general, imitation for $\rho > .50$ was under the predicted levels, while for $\rho < .50$ it was above the predicted levels - a finding in general agreement with Kanareff and Lanzetta (1958) and Lanzetta and Kanareff (1959).

More recently, Bandura and his associates (Bandura, Ross, & Ross, 1961, 1963a, b; Bandura, 1962, 1965a, b, c; Bandura & Walters, 1963; Bandura & McDonald, 1965; Bandura, Grusec, & Menlove, 1966) have raised questions about the adequacy of instrumental conditioning as a model for the acquisition of imitative behavior. Their criticism is focused on two observations. The first is that the instrumental model does not offer an efficient mechanism for the acquisition of responses by imitation which are not already in the imitator's repertoire. The second is that reinforcement of the imitator often does not occur at the time that learning takes place. In some situations the conditions may not require that the imitator make the response at the time of learning; in other situations it is the model to be imitated, not the imitator, who is overtly reinforced during the learning period.

They propose, instead, a two factor theory (Bandura, 1962, 1965a, c; Bandura & Walters, 1963). One factor is the classical conditioning of the sensory experience representing the model's behavior to the positive primary reinforcement which occurs contiguously with the model's behavior. Once conditioning takes place, the model's behavior acquires secondary reinforcing characteristics. The

reproduction of the model's behavior by the imitator is subsequently self-reinforcing. Thus, the acquisition of novel responses exhibited by the model is possible and proceeds fairly rapidly. The second factor is instrumental conditioning of already learned responses to the reinforcement contingencies present in the situation. This factor principally influences the performance of imitative responses but is, at best, a cumbersome process for their acquisition.

Typical of the experiments demonstrating this position is that of Bandura (1965a) in which three groups of children observed a film in which an adult model depicts novel sequences of aggressive behavior. One group was shown a version in which the model is rewarded following the aggressive behavior; the second group saw a version in which the model is punished; while in the third group's version, the model is neither rewarded nor punished. Both the model-rewarded and the model-neutral groups subsequently imitated significantly more of the model's behavior than did the model-punished group. However, when an incentive for imitation was introduced, the model-punished group increased their imitative responses to a level not significantly different from the other two groups.

Bandura interprets the findings as supporting the contiguity theory of acquisition by observation. The model-punished group apparently learned the behavior by observation but did not perform it until reinforcement for it was forthcoming. However, Bandura points out that observation alone is not a sufficient basis for learning since, even after an incentive for imitation was introduced, only a fraction of the model's behavior was imitated by any of the groups.

More significantly, he indicates that an interpretation based on the generalization of a history of reinforcement of imitative behavior would also account for the results. Given an individual who has acquired a repertoire of ordinary responses, the acquisition of a novel combination of those responses can be counted as an instance of instrumental conditioning in which imitation is a secondary reinforcer. This is, essentially, the position held by Miller and Dollard (1941) with the addition that the act of imitation itself is reinforcing.

The problem

In the studies cited, imitation was seen as a function strictly of the direct reinforcement of such behavior - i.e., imitation was expected when it was instrumental to being "right". The pressure to imitate exerted by the model-to-be-imitated, quite apart from the reinforcing contingency of imitation, has, except in the Bandura, et al., studies, for the most part been ignored. Viewing the effect of the model-to-be-imitated in light of the conformity studies of Asch (1951, 1952, 1956), Crutchfield (1955), and Sherif and Sherif (1956), in which the effects of group pressure in contravening the evidence of sensory inputs are amply demonstrated, one would expect higher levels of imitation than have been reported in the literature on imitative behavior.

Although Asch found but a small effect when his influencing group was reduced to a majority of one, he was attempting to get agreement to large errors of judgments for the lengths of lines - errors as large as 1-3/4". The studies reviewed here, however, involve in most cases ambiguous situations so that pressure to imitate would be expected to operate more effectively.

It is quite true that, operationally defined, conformity and imitation involve distinctly different procedures. In conformity studies, a group's perceptual (e.g., Asch, Sherif & Sherif) or attitudinal (Crutchfield) judgment, most often involving a distortion, is arrayed against the judgment of one person. To the extent that the one person yields to the group's consensus, he is said to be conforming. Studies of imitation, on the other hand, involve a single person's, the model's, behavior which is observed by another person, the imitator, and, most often, not involving a distortion. To the extent that the second person then produces the behavior that the model exhibited, the former is said to be imitating.

In terms of the effect on the behavior of _S_s in the two types of studies, however, the changes may be conceptualized as being on a continuum. Conformity may be viewed as involving a _transformation_ of a well-established pattern of behavior to its opposite, e.g., changing from correct judgments about the lengths of lines to incorrect ones (Asch). Along this continuum, imitation can be seen as involving an _increase_ in the incidence of a behavior not very well-established or not at all established, e.g., engaging in aggressive behavior in novel ways (Bandura). It does not seem unreasonable, therefore, to compare outcomes of the two types of studies or to expect that similar principles of social influence or pressure operate in both.

Elements of both conformity and imitation were combined in this study. In terms of operations, the behavior of two models was presented to one person. In this respect, this study resembled conformity experiments. On the other hand, in terms of _S_'s behavior, neither a

transformation of an established pattern of behavior, nor a distortion of perceptual or attitudinal judgments was involved. Rather, an ambiguous situation was employed and a novel pattern of behavior was to be established. In this respect, the study resembled imitation experiments.

Specifically, the present study was designed to evaluate the effect of different rates of pressure to imitate, here to be designated PTI, when it is varied orthogonally to the rate of reinforcement of imitation, here to be designated ROI.

Different magnitudes of PTI can be produced by providing S with the opportunity to imitate one or both of two models (dummy Ss, D_1 and D_2). By varying the ratio of agreement between D_1 and D_2 to the total number of stimulus presentations, different rates of PTI can also be generated.

ROI can be produced by indicating to S that one model, D_1, had made the correct choice. Varying the ratio of correct D_1 choices to the total number of D_1 choices gives rise to different rates of ROI.

As experimental events, ROI and PTI may be viewed as probabilities of reinforcement and agreement respectively. It should be possible to incorporate both into a mathematical model that will describe the joint effect of the two on imitative behavior.

The stochastic model

Two models were considered in terms of appropriateness to the theoretical framework and in terms of convenience of use. The Estes and Straughan (1954) model, derived from a statistical association theory, appeared to be the least cumbersome in terms of application. In that

model, only one parameter, θ, is unknown. The other values in the model are all empirically determinable. The Bush and Mosteller (1955) model, on the other hand, is based on the Hullian principle of the positive effect of reinforcement. Since the theoretical bias of this study is a Hullian one, the latter model would be more appropriate. However, it is more difficult in application in that two parameters, one for the effect of reinforcement and one for the effect of non-reinforcement, need to be found.

Fortunately for the resolution of the problem, it has been shown (Hilgard, 1956) that the two models are equivalent under certain conditions. If the assumptions can be made that the occurrence of the alternative events have the same consequences, that the work involved in responding has little or no effect on the choices to be made, and that there is no risk in choosing one or another of the alternatives, then the two parameters of the Bush and Mosteller model are equal and the form of their equations is identical, except for notation, to the equation of the Estes and Straughan model.

Empirical support for accepting the assumptions in the imitation situation to be used here was found in the Shwartz study cited earlier (Bush & Mosteller, 1955). In that study, the two parameter estimates were quite divergent for the grade school children but nearly equal for the high school students. Since college students were to serve as Ss in this study, it seems a safe assumption that the two parameters would be near equality for them as well. Accordingly, the equations used for curve-fitting are those from the Estes and Straughan model.

Two equations are involved in the model. Equation (1) predicts the mean proportion of responses in any given block of trials. Equation (2) is a summation of Equation (1) over trial blocks and is essential to the estimation of the parameter θ. The equations as adapted from Estes and Straughan (1954, p. 230) are:

Equation (1) $$\overline{P}(m) = \rho-[\rho-\overline{P}(1)]\ (1-\theta)^{n(m-1)},\quad (m = 1, 2,\ldots, k),$$

where

- m is the ordinal number of a block of trials,
- $\overline{P}(m)$ is the predicted mean proportion of responses in trial block m,
- ρ is the rate of reinforcement,
- $\overline{P}(1)$ is the observed mean proportion of responses in trial block 1,
- $1-\theta$ is a growth factor such that $0\leq\theta\leq 1$,
- n is the number of trials in each block, and
- k is the number of trial blocks;

Equation (2) $$\sum_{m=1}^{k}\overline{P}(m) = \frac{k\rho-[\rho-\overline{P}(1)]\ [1-(1-\theta)^{nk}]}{1-(1-\theta)^{n}}$$

where

- $\sum_{m=1}^{k}\overline{P}(m)$ is taken as the sum of the observed mean proportion of responses over k trial blocks.

Equation (2) contains only one unknown, θ. Solving for θ by the Newton-Raphson method (Kunz, 1957) is fairly straightforward, since the value of θ is restricted so that $0\leq\theta\leq 1$ and only one root needs to be found.

Summary

By manipulating two sources of influence, ROI and PTI, on imitative behavior independently, their individual contributions to the acquisition and extinction rates, and to the level of imitation, can be determined. Such a procedure may shed additional light on the factors involved in imitation learning and provide a more adequate basis for reconciling the conflicting findings reported in the literature.

Additionally, two hitherto distinct lines of investigation, each having its own techniques of experimentation and referring findings to its own theoretical structures, are brought together in a single study and an attempt is made to present a unifying framework. One line of research derives from the work of Miller and Dollard (1941) and is cast in the framework of learning theory. The second follows from the work of Asch (1951, 1952, 1956) and Crutchfield (1955) and appeals to cognitive processes for its explanatory concepts. Finally, an attempt is made to evaluate findings in terms of a stochastic model.

CHAPTER II

METHOD: EXPERIMENT I

Experimental design

ROI and PTI were varied orthogonally across three values (.00, .33, and .66). These values were selected to give a fairly broad range without unduly complicating the computation of the probabilities involved.

Subjects

The Ss were 72 University of Florida students in two introductory Psychology courses who participated in the experiment as part of their course requirement. They were randomly assigned in groups of four to the nine conditions of the experiment, two groups of four to each condition. No attempt was made to control for sex so that groups varied in this respect from all female groups, to groups with one female and three males. Altogether 53 females and 19 males participated.

Apparatus

A modified Crutchfield apparatus was used. Briefly, it consists of a booth for each of four Ss and a booth for the E. In each S's booth is a panel on which are located four rows of three 25-watt bulbs and a row of three silent mercury switches as shown in Figure 2.

Each switch operates the light immediately above it on the bottom row and a light, corresponding to that position and that booth, on a

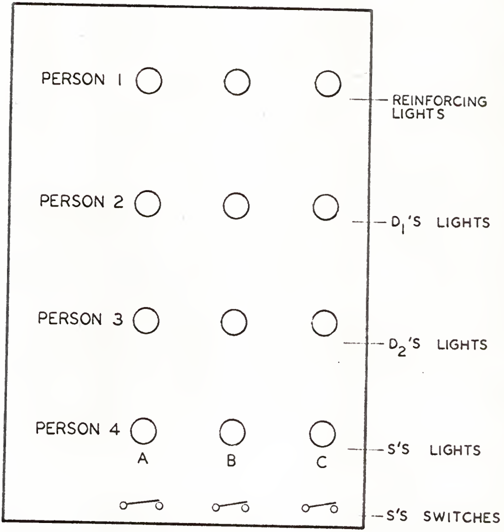

Figure 2. Diagram of the panel of lights in S's booth.

panel in E's booth. The other three rows of lights are operated from E's booth so that any lights in the three upper rows can be turned on by E in any desired sequence or combination to all Ss simultaneously. S has no way of determining who in fact is operating the lights on the rows other than his own. It is thus possible by suitable instruction to lead S to believe that each of the upper rows of lights is operated by a different one of the three other Ss present with him in the laboratory.

Procedure

A trial consisted of:

1) The display of a D_1 choice in the Person 2 row on all Ss' boards

2) The display of a D_2 choice in the Person 3 row on all Ss' boards

3) Selection by each S individually of an alternative in the Person 4 row. The selection was displayed on only that S's board and on E's board.

4) The display of the correct choice for that trial (reinforcement) on the Person 1 row on all Ss' boards. Ss had been told in advance that S_1 would indicate the correct choice from a prepared list.

5) Approximately 15 seconds after the display of the reinforcement light, the correct light, D_1 light, D_2 light, and S-selected lights, in that order, were switched off.

The sequence of D_1 choices, D_2 choices, and reinforcements were prearranged for 189 trials in random-like (Popper, 1959) Blocks of 27 Trials, with the restriction that each of the three lights occur equally often in each Block of 27 Trials. The reinforcing sequence was the same for all nine groups. The D_1 sequences, similarly randomized, were the same for each of the three groups receiving the same ROI rate. Each of the nine groups was exposed to a different D_2 sequence.

The ROI rate (ρ) - i.e., the proportion of the time that D_1 choices were designated as correct - was .00 for three groups, .33 for another three groups, and .67 for the remaining three groups.

The PTI rate (ω) - i.e., the proportion of the time that D_1 and D_2 choices coincided - was .00 for one of each of the three groups receiving the same ROI treatment, .33 for another one of each of the three groups, and .67 for the remaining one of each of the three groups. Thus, there was one group for each of the following nine ROI x PTI treatments: .00 x .00, .00 x .33, .00 x .67, .33 x .00, .33 x .33, .33 x .67, .67 x .00, .67 x .33, and .67 x .67.

Instructions were the same for all groups. Ss were informed that they were to participate in a group learning experiment and that "for security reasons", they were not to discuss what they did after they left. Once seated in his booth, each S was given identical typewritten instructions. All Ss were assigned the number four.

This was followed by a brief description of the response the S was to make. Other further pertinent portions of the instructions were:

> Please do not try the switches until you are called upon to do so by your number (4). I will say, "Will person number X respond." If that is your number, please respond by selecting one of the switches to turn on and leave on until asked to turn it off.
>
> The object is to select the correct light for that trial.
>
> After each of you has made a selection, person number (1), who has been given a list of correct selections, will turn his switch on and the light correct for that trial will come on in all the booths. This will be in the top row of lights. You will then be asked to turn your switch off and a new trial will begin.
>
> Remember, do not respond until asked to do so by your number (4).

> I will come to each booth to answer any questions you may have.

E then made certain that each S knew what he was to do and answered questions by pointing to pertinent portions of the instructions. The 189 trials followed.

CHAPTER III

RESULTS: EXPERIMENT I

Three response variables were selected for analysis.

D_1-imitative responses - S's agreement with D_1's choice only when D_1 and D_2 were not in agreement.

D_2-imitative responses - S's agreement with D_2's choice only when D_1 and D_2 were not in agreement.

$D_{1\&2}$-imitative responses - S's agreement with the choice made by both D_1 and D_2 when D_1 and D_2 were in agreement.

The response measure in all cases was the ratio of responses made to the total number of that response possible in each Block of 27 Trials.

D_1-imitative responses

Figure 3B shows the mean proportions of D_1-imitative responses for the ρ=.00, .33, and .67 conditions across all PTI conditions. The smooth curves are the predicted levels of performance based on the Estes and Straughan (1954) model for verbal conditioning as generated by Equations (1) and (2) cited earlier. The values of θ computed for these curves and the ρ values used in the computations are given in Table 1.

The mean proportions of D_1-imitative responses for the PTI=.00, .33, .67 conditions across all ROI conditions are shown in Figure 3A. Since there is no clear basis upon which to choose appropriate ρ values in Equations (1) and (2), no attempt was made to fit curves to these data.

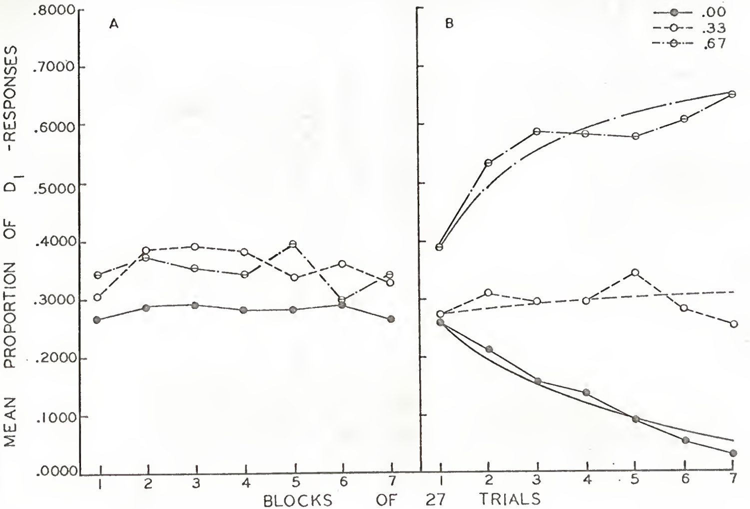

Figure 3. Mean proportion of D_1-responses on each of seven 27-Trial Blocks under (A) .00, .33, and .67 PTI, across all ROI conditions and (B) .00, .33, and .67 ROI across all PTI conditions. Smooth curves generated by Equation (1) have been fitted to the data of (B).

TABLE 1

VALUES OF ρ AND θ USED IN EQUATION (1) TO GENERATE THE THEORETICAL CURVES OF FIGURES 3B, 4A, 4B, AND 4C. (DECIMALS OMITTED.)

PTI	ROI					
	00		33		67	
	ρ	θ	ρ	θ	ρ	θ
00	0000	0222	3333	0000	6667	0164
33	0000	0058	4444	0011	7778	0173
67	0000	0088	5555	0039	8889	0030
All	0000	0098	3333	0060	6667	0166

Figures 4A, B, and C show the mean proportions of D_1-imitative responses for each of the nine ROI X PTI conditions and the fitted curves generated by Equation (1). Referring to Table 1, it is seen that adjusted ρ values were used in fitting curves to the data of the .33 x .33, .33 x .67, .67 x .33, and .67 x .67 conditions.

The rationale for this procedure was that the D_1-imitative response also occurred as a part of the $D_{1\&2}$-imitative response. The latter response was possible on ω proportion of the time and correct on ρ proportion of the time. At first glance, it seemed in order to increase the ρ values used in Equations (1) and (2) by $\rho \times \omega$. However, this would have given an adjusted ρ>1.00 for the .67 x .67 condition. Furthermore, the increases in the ρ values for both the .33 x .67 and .67 x .33 conditions would have been of equal magnitude (.33 x .67= .67 x .33), despite the fact that the $D_{1\&2}$-response could occur with twice the probability in the .33 x .67 condition while reinforcement of it could occur with twice the probability in the .67 x .33 condition.

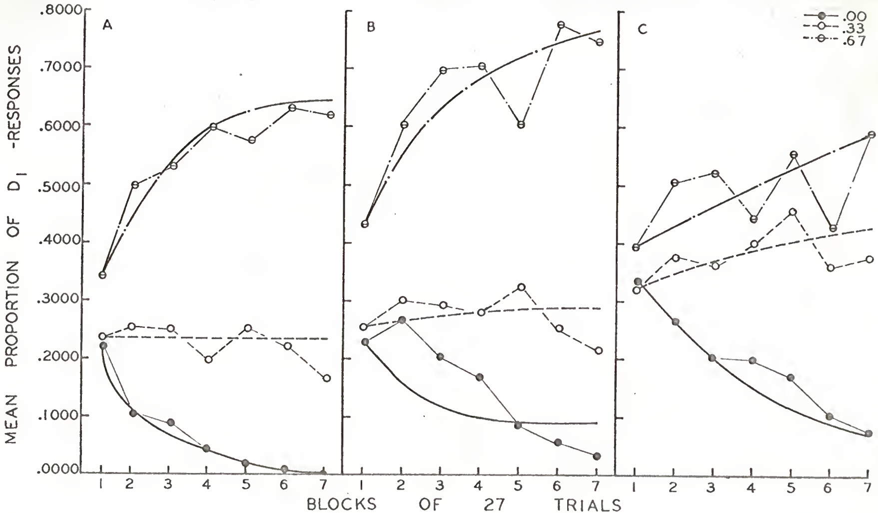

Figure 4. Mean proportion of D_1-responses on each of seven 27-Trial Blocks under .00, .33, and .67 PTI for (A) .00 ROI, (B) .33 ROI, and (C) .67 ROI. Smooth curves generated by Equation (1) have been fitted to the data.

Accordingly, the increases in ρ were kept to .1111 for the .33 x .33 and .67 x .33 conditions and to .2222 for the .33 x .67 and .67 x .67 conditions.

As Figure 3B shows, the proportion of D_1-imitative responses over Trial Blocks varied directly with the ROI level. Under the ROI=.00 condition, the proportion of D_1-imitative responses was depressed to near .00 (.03) on the seventh Block of Trials; under the ROI=.33 condition, the proportion remained fairly constant at about .30, varying between .25 and .35; under the ROI=.67 condition, the proportion increased over Trial Blocks to .65 at the seventh Block. The fit of the theoretical curves to the plotted points is deferred for later discussion.

The mixed-factorial with repeated-measurements analysis of variance of the data (Lindquist, 1953) in Table 2 shows that both the

TABLE 2

ANALYSIS OF VARIANCE OF THE PROPORTION OF D_1-IMITATIVE RESPONSES

Source	df	MS	*F*	*p*
Between *Ss*	71	.3387		
ROI	2	7.8691	76.64	<.001
PTI	2	.3146	3.06	
ROI x PTI	4	.3031	2.95	<.025
Error (b)	63	.1027		
Within *Ss*	432	.0216		
Trial Blocks (T)	6	.0234	1.38	
T x ROI	12	.1168	9.47	<.001
T x PTI	12	.0148	<1	
T x ROI x PTI	24	.0145	<1	
Error (w)	378	.0176		
Total	503			

ROI effect and the Trials x ROI interaction were significant ($p<.001$). In the absence of a significant F for Trial Blocks, the suggestion is strong that the rates of acquisition and extinction, as well as the levels of imitation reached, differed significantly for the different ROI conditions.

The effect of varying PTI, as shown in Figure 3A, is not so clear cut. There is a fairly stable level of D_1-responding for the three levels of PTI, used with little variation over Trial Blocks. The absence of a significant F for the Trials x PTI interaction in Table 2 supports this observation. The F for the rate of PTI, falling short of significance, suggests no strong differences among the proportions of D_1-responses for different levels of PTI.

The interpretation of the significant ROI x PTI interaction ($p<.025$) involves a comparison of the means that enter into it. The abscissa of Figure 5 shows an arrangement of conditions in which it is assumed that the effect of increasing the PTI rates within each ROI rate and increasing the ROI rates represent an ordered sequence on a continuum of increasing reinforcement. The assumption is justified in that the ROI rate reinforced imitative responses directly whereas the PTI rate represents indirect reinforcement. The relationship of the means is in the expected direction with one exception. Increasing PTI levels within each ROI condition increased the mean proportion of total D_1-responses except for the .67 x .67 group. The mean for that group is below the means of the other two PTI groups given the ROI=.67 condition.

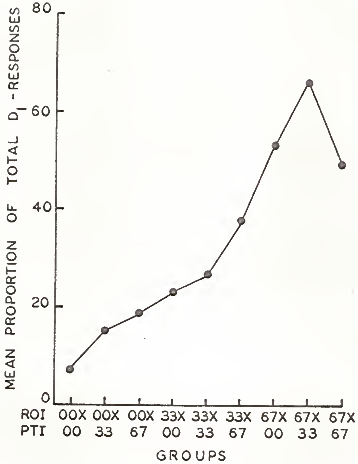

Figure 5. Mean proportion of total D_1-responses for each of the nine ROI x PTI groups.

A *post hoc* comparison of the differences between means by the Scheffé method (Hays, 1963) is given in Table 3. Of the nine comparisons

TABLE 3

DIFFERENCES* BETWEEN MEAN PROPORTIONS OF TOTAL D_1-RESPONSES FOR EACH ROI X PTI GROUP. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. UNDERLINED FIGURES ARE COMPARISONS WITHIN ROI LEVELS. (DECIMALS OMITTED.)

ROI			00		33			67		
	PTI		33	67	00	33	67	00	33	67
		Mean	15	19	23	27	38	54	66	47
00	00	07	08	12	16	20	31	47	59	42
	33	15		04	08	12	23	39	51	34
	67	19			04	08	19	35	47	30
33	00	23				04	15	31	43	26
	33	27					11	27	39	22
	67	38						16	28	11
67	00	54							12	-05
	33	66								-07

*When absolute value of differences $\geq .10$, they are significant at the .05 level (F=1.96; df=8, 495).

within ROI levels (underlined in the table), four are significant ($p<.05$) in the expected direction, three are in the expected direction but are not significant, and two are opposite to the expected direction, one of them significantly so ($p<.05$). The 27 comparisons between ROI levels are in the expected direction and all but three are significant.

D_2-imitative responses

Figure 6A shows the mean proportion of D_2-responses for PTI=.00, .33, and .67 conditions across ROI groups. The predicted curves have

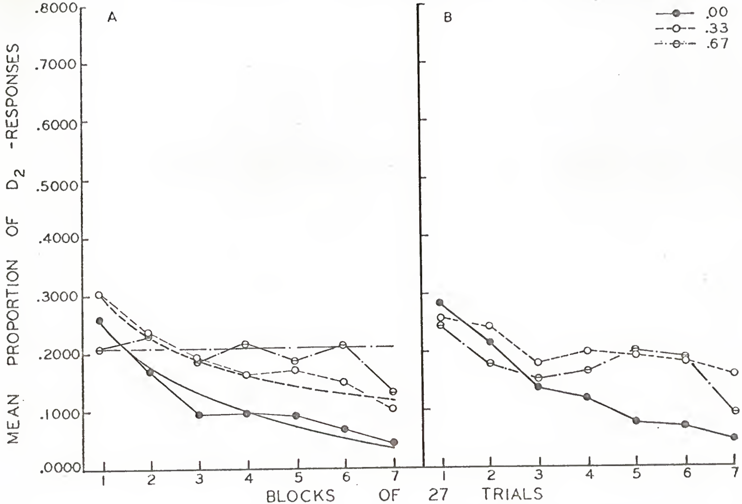

Figure 6. Mean proportion of D_2-responses on each of seven 27-Trial Blocks under (A) .00, .33, and .67 PTI across all ROI conditions and (B) .00, .33, and .67 ROI across all PTI conditions. Smooth curves generated by Equation (1) have been fitted to the data of (A).

been fitted to these points rather than the ROI data since there was no compelling reason to believe that reinforcement of D_1-responses would have a direct effect on the making of D_2-responses. At the same time, the D_2-response was reinforced as part of the $D_{1\&2}$-response with a frequency determined by the PTI level. The rate of reinforcement of the D_2-response was then more directly a function of the PTI level than of the ROI level.

The θ and ρ values used in plotting the curves are given in Table 4. The rationale set forth in determining the ρ values to be used

TABLE 4

VALUES OF ρ AND θ USED IN EQUATION (1) TO GENERATE THE THEORETICAL CURVES OF FIGURES 6A, 7A, 7B, AND 7C. (DECIMALS OMITTED.)

ROI	PTI					
	00		33		67	
	ρ	θ	ρ	θ	ρ	θ
00	0000	0194	0000	0130	0000	0059
33	0000	0086	1111	0042	2222	0005
67	0000	0129	2222	0000	4444	0041
All	0000	0155	1111	0070	2222	0000

in plotting the theoretical curves for D_1-responses was applied here. Since <u>all</u> of the reinforcement for the D_2-response could occur only $\omega \times \rho$ proportion of the time, the objections raised earlier against the procedure are not so applicable in this instance. The ρ values used for the curves in Figure 6A were the mean ROI value for each of the three groups getting the same PTI treatment multiplied by the PTI value.

The mean proportions of D_2-imitative responses for the ROI=.00, .33, and .67 conditions across all PTI conditions are shown in Figure 6B. For the reasons set forth above, no attempt was made to fit theoretical curves to the data.

Figures 7A, B, and C show the mean proportions of D_2-responses for each of the nine ROI x PTI conditions. The curves generated by Equation (1) have been fitted to the data based on θ values given in Table 4.

The analysis of variance of these data is given in Table 5. The *F*s for both Trials x ROI and Trials x PTI are significant as is the *F*

TABLE 5

ANALYSIS OF VARIANCE OF THE PROPORTION OF D_2-IMITATIVE RESPONSES

Source	df	MS	*F*	*p*
Between *Ss*	71	.0797		
ROI	2	.1839	3.22	<.05
PTI	2	.3177	5.57	<.005
ROI x PTI	4	.2659	4.64	<.005
Error (b)	63	.0571		
Within *Ss*	432	.0174		
Trial Blocks (T)	6	.1950	13.81	<.001
T x ROI	12	.0324	2.30	<.005
T x PTI	12	.0279	1.98	<.05
T x ROI x PTI	24	.0118	<1	
Error (w)	378	.0141		
Total	503			

for Trials (p<.025, <.05, and <.001, respectively). Examining Figures 6A and B, a generally downward trend for all ROI and PTI conditions is evident on successive Trial Blocks, while the slopes or the rates of

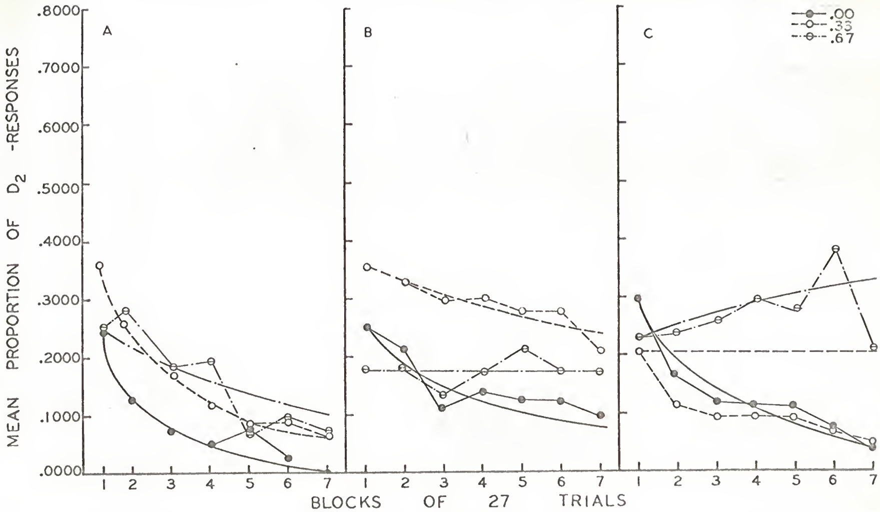

Figure 7. Mean proportion of D_2-responses on each of seven 27-Trial Blocks under .00, .33, and .67 PTI for (A) .00 ROI, (B) .33 ROI, and (C) .67 ROI. Smooth curves generated by Equation (1) have been fitted to the data.

decrease in the proportions of D_2-responses are seen to vary for the different ROI and PTI conditions. Also to be noted is the minor reversal between the ROI=.33 and ROI=.67 conditions on the seventh Block of Trials in Figure 6B.

Means entering into the Trials x ROI and Trials x PTI interaction were evaluated by the Scheffé method and are shown in Tables 6 and 7, respectively. The comparisons are between the mean proportions of

TABLE 6

DIFFERENCES* BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES ON THE FIRST AND LAST THREE BLOCKS OF TRIALS UNDER EACH ROI CONDITION. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. (DECIMALS OMITTED.)

Trial Blocks			First Three		Last Three		
	ROI		33	67	00	33	67
		Mean	22	19	06	17	18
First three	00	21	01	-02	-15	-04	-03
	33	22		-03	-16	-05	-04
	67	19			-13	-02	-01
Last three	00	06				11	12
	33	17					01

*When absolute value of differences $\geq .07$, they are significant at the .05 level (F=2.23; df=5, 426).

D_2-responses on the first and last three Blocks of Trials under each ROI condition across all PTI conditions (Table 6) and under each PTI condition across all ROI conditions (Table 7). Mean performance on the last three Blocks of Trials was significantly lower ($p<.05$) for ROI=.00 and PTI=.00 than for the other two values of ROI and PTI (fourth row

TABLE 7

DIFFERENCES* BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES ON THE FIRST AND LAST THREE BLOCKS OF TRIALS UNDER EACH PTI CONDITION. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. (DECIMALS OMITTED.)

Trial Blocks			First three		Last three		
	PTI		33	67	00	33	67
		Mean	24	21	07	14	18
First three	00	18	06	03	-11	-04	00
	33	24		-03	-17	-10	-06
	67	21			-14	-07	-03
Last three	00	07				07	11
	33	14					04

*When absolute value of differences $\geq .07$, they are significant at the .05 level (F=2.23; df=5, 426).

in each table). Additionally, for ROI=.00 and PTI=.00, there was a significantly lower mean proportion of D_2-responses on the last three Blocks of Trials than on the first three Blocks for all values of ROI and PTI (third column in each table; $p \leq .05$). The other significant differences are between the first three Blocks of Trials for PTI=.33 and .67 and the last three Blocks of Trials for PTI=.33 in Table 7.

Thus, the level of performance at the outset did not differ significantly for the three ROI and three PTI conditions. On the other hand, the .00 ROI and .00 and .33 PTI conditions led to a significant decrement in level of performance for the last three Blocks of Trials, substantiating the conclusion that the D_2-response was being extinguished.

The mean proportions of total D_2-responses for each ROI x PTI condition are shown in Figure 8. The differences between the means as evaluated by the Scheffé method for <u>post hoc</u> comparisons are given in Table 8. The proportion of total D_2-responses was significantly higher

TABLE 8

DIFFERENCES* BETWEEN MEAN PROPORTIONS OF TOTAL D_2-RESPONSES FOR EACH ROI X PTI GROUP. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. (DECIMALS OMITTED.)

ROI			00		33			67		
	PTI		33	67	00	33	67	00	33	67
		MEAN	16	16	14	29	17	13	11	27
00	00	08	08	08	06	21	09	05	03	19
	33	16		00	-02	13	01	-03	-05	11
	67	16			-02	13	01	-03	-05	11
33	00	14				15	03	-01	-03	13
	33	29					-12	-16	-18	-02
	67	17						-04	-06	10
67	00	13							-02	14
	33	11								16

*When absolute value of differences $\geq .10$, they are significant at the .05 level ($F=1.96$; $df=8, 495$).

for the .33 x .33 and .67 x .67 groups than for the other ROI x PTI groups. No other differences were significant. Examining Figure 8, there appears to be no consistent relationship between changes in ROI and PTI and the proportion of total D_2-responses.

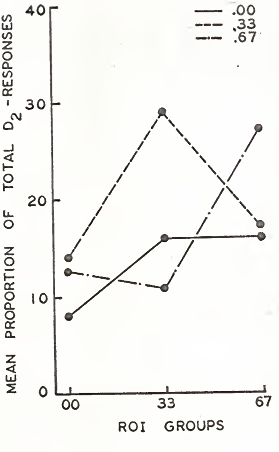

Figure 8. Mean proportion of total D_2-responses for each of the nine ROI x PTI groups.

$D_{1\&2}$-imitative responses

The $D_{1\&2}$-imitative responses could occur only when D_1 and D_2 were in agreement. Thus, the .00 PTI groups had no opportunity to give this response. The analysis, therefore, is of the six groups that were given .33 or .67 PTI.

The proportions of $D_{1\&2}$-responses made by the .00, .33, and .67 ROI groups in each Block of 27 Trials are shown in Figure 9B. The fitted curves were plotted using the ρ and θ values given in Table 9. As with

TABLE 9

VALUES OF ρ AND θ USED IN EQUATION (1) TO GENERATE THE THEORETICAL CURVES OF FIGURES 9B, 10A, and 10B. (DECIMALS OMITTED.)

PTI	ROI					
	00		33		67	
	ρ	θ	ρ	θ	ρ	θ
33	0000	0123	5556	0000	8889	0082
67	0000	0082	4444	0000	8889	0064
All	0000	0108	5000	0000	8889	0071

the D_1- and D_2-responses, the values of ρ were adjusted for the .33 and .67 ROI conditions. The reasoning was analogous. Since the $D_{1\&2}$-responses include imitating D_1 as a part-response and the D_1-response was independently reinforced ρ x $(1-\omega)$ proportion of the time, the ρ values used in Equations (1) and (2) should be increased by that amount. However, as with the D_1-responses and for similar reasons, an arbitrary upper limit of .2222 was placed on the increase in ρ.

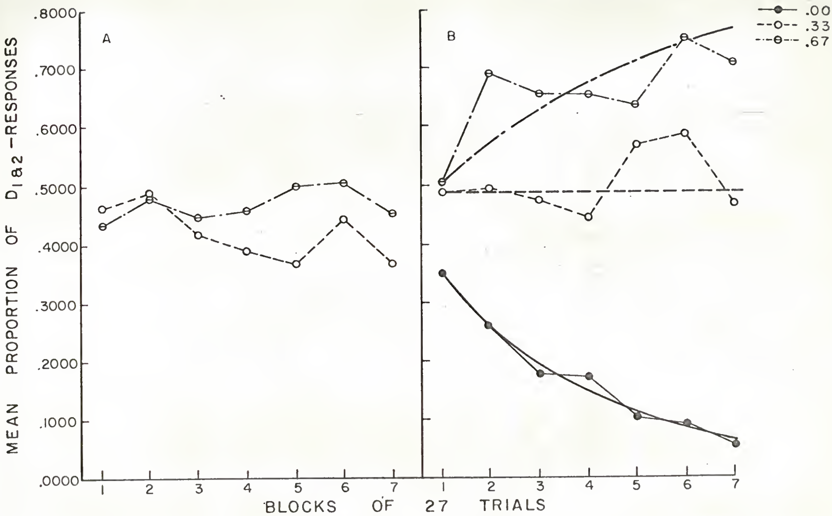

Figure 9. Mean proportion of $D_{1\&2}$-responses on each of seven 27-Trial Blocks under (A) .33 and .67 PTI across all ROI conditions and (B) .00, .33, and .67 ROI across all PTI conditions. Smooth curves generated by Equation (1) have been fitted to the data of (B).

Examining Figure 9B, it can be seen that the proportion of $D_{1\&2}$-responses over Trial Blocks tended to vary directly with the value of ROI. This is most clear for ROI=.00, where the decrease on successive Trial Blocks continues until by the seventh Block the proportion is near zero. For ROI=.67, there is a suggestion of an increase in proportion of $D_{1\&2}$-responses on successive Trial Blocks. However, because of the high initial rate and the Block to Block variations, the trend is not a very clear one. The proportions for ROI=.33 tend to remain near the initial level; but here again, the variation from Block to Block obscures the trend.

Figure 9A shows the proportion of $D_{1\&2}$-responses made in each Block of Trials by the .33 and .67 PTI groups. No attempt was made to fit theoretical curves to these data since there was no clear basis upon which to choose appropriate ρ values. There appears to be no great differences between the .33 and .67 PTI groups, nor is there any clear cut change on successive Trial Blocks.

The performance of each of the ROI x PTI groups by Trial Blocks is shown in Figures 10A, B, and C. There is no significant difference in the level of performance between the .00 x .33 and .00 x .67 groups, both tending toward extinction from the initial levels. The .33 x .33 group maintains a level of response near the initial .33 proportion of $D_{1\&2}$-responses, while the .33 x .67 group, beginning with a proportion of approximately .60, increases its proportion of $D_{1\&2}$-responses to near .80. The .67 x .33 and .67 x .67 groups both increase the proportion of $D_{1\&2}$ responses from their initial level, the .67 x .33 groups starting at a higher level and maintaining their superiority over the seven Blocks of Trials.

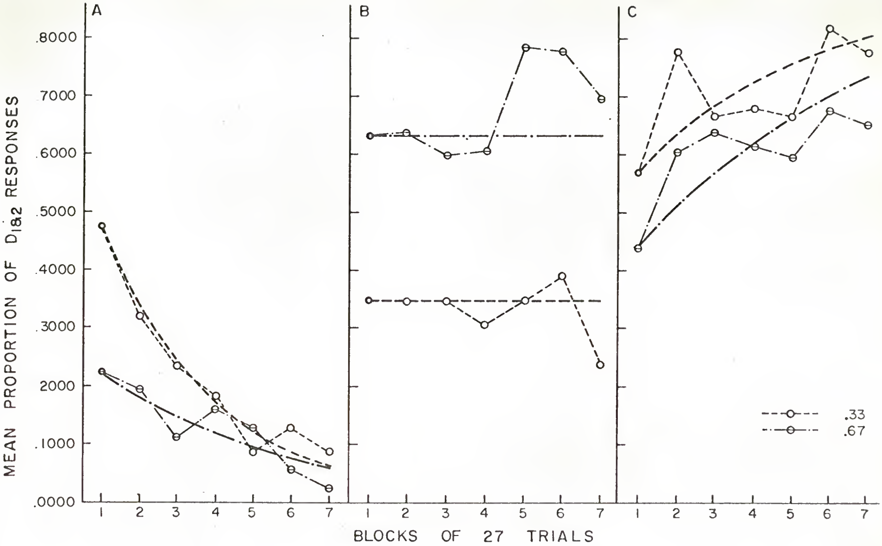

Figure 10. Mean proportion of $D_{1\&2}$-responses on each of seven 27-Trial Blocks under .33 and .67 PTI for (A) .00 ROI, (B) .33 ROI, and (C) .67 ROI. Smooth curves generated by Equation (1) have been fitted to the data.

The analysis of variance of these data is shown in Table 10. The pattern of significant Fs is similar to that observed for the D_1-responses and may be interpreted in the same way. Both the ROI effect

TABLE 10

ANALYSIS OF VARIANCE OF THE PROPORTION OF $D_{1\&2}$-IMITATIVE RESPONSES

Source	df	MS	F	p
Between Ss	47	.5023		
ROI	2	6.9290	49.06	<.001
PTI	1	.2151	1.52	
ROI x PTI	2	1.8128	12.85	<.001
Error (b)	42	.1411		
Within Ss	288	.0263		
Trial Blocks (T)	6	.0318	1.52	
T x ROI	12	.1400	6.68	<.001
T x PTI	6	.0383	1.83	
T x ROI x PTI	12	.0164	<1	
Error (w)	252	.0209		
Total	335			

and Trials x ROI interaction were significant ($p<.001$), while the Trials effect did not reach significance. This lends strong substantiation to the earlier assertion of differences in the rate of acquisition and extinction of $D_{1\&2}$-responses, as well as in the level of responding reached under the different ROI conditions.

Although the effect of different PTI conditions was not significant, varying PTI did influence the level of $D_{1\&2}$-responding as seen from the significant ROI x PTI interaction ($p<.001$). The relationship of the mean proportions entering into the interaction is shown in

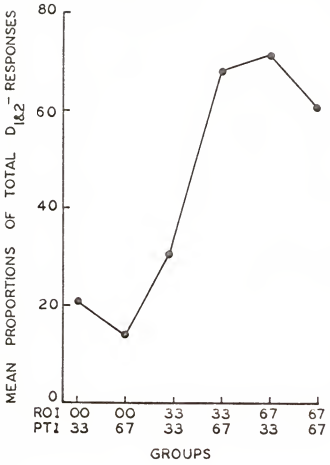

Figure 11. Mean proportion of total $D_{1\&2}$-responses for each of the six ROI x PTI groups.

Figure 11,[1] and the means are compared by the Scheffé method in Table 11. Increasing PTI within each ROI condition did not have a consistent

TABLE 11

DIFFERENCES* BETWEEN MEAN PROPORTIONS OF TOTAL $D_{1\&2}$-RESPONSES FOR EACH ROI X PTI GROUP. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. (DECIMALS OMITTED.)

ROI	PTI	Mean	00	33		67	
	PTI		67	33	67	33	67
		Mean	14	33	68	71	60
00	33	21	-07	12	47	50	39
	67	14		19	54	57	46
33	33	33			35	38	26
	67	68				03	-08
67	33	71					-11

*When absolute value of differences $\geq .09$, they are significant at the .05 level (F=2.23; df=5, 331).

effect. For the .00 and .67 ROI conditions, increasing PTI had the effect of decreasing the proportion of $D_{1\&2}$-responses significantly. On the other hand, increasing PTI for the .33 ROI groups raised the proportion of $D_{1\&2}$-responses significantly. In fact, the .33 x .67 group performed as well as the two .67 ROI groups.

D_1-, D_2-, and $D_{1\&2}$-responses compared

The statistical treatment of results required that the three responses be analyzed separately, there being no appropriate model available

[1]The abscissa is ordered in the same way as it was in the similar figure for D_1-responses.

which would allow a comprehensive analysis. However, it is of interest to examine the responses side by side for each of the nine groups. Such a comparison is shown in Figures 12A, B, C, 13A, B, C, 14A, B, and C.

For the .00 ROI groups in Figures 12A, B, and C, the three responses are undifferentiated under the three PTI conditions. There is some slight increase in asymptotic level with increasing ROI; but, generally, it can be seen that all three imitative responses tend to be extinguished.

Examining Figures 13A, B, and C, the effect of PTI is seen to be a dramatic one for the .33 ROI groups. While the .33 x .33 group shows similar levels of each response, the .33 x .00 and .33 x .67 do not. The .33 x .00 group shows a somewhat higher proportion of D_1-responses than D_2-responses. (Under the .00 PTI condition, $D_{1\&2}$-responses are not possible.) For the .33 x .67 group, the proportion of $D_{1\&2}$-responses is almost twice the proportion of D_1-responses on each Trial Block and the latter proportion is somewhat more than twice the proportion of D_2-responses.

Turning to the .67 ROI groups (Figures 14A, B, and C), the three responses are again seen to be affected differently by the three PTI conditions. The proportions of D_1-responses on successive Trial Blocks for the .67 x .00 group give rise to a typical acquisition curve with asymptote at about .62, while the proportions of D_2-responses over Trial Blocks resemble an extinction curve with asymptote near .00. For the .67 x .33 group, the proportions of both D_1- and $D_{1\&2}$-responses quickly reach a level well above the .67 reinforcement rate, while the proportions of D_2-responses show a very slight tendency to extinction.

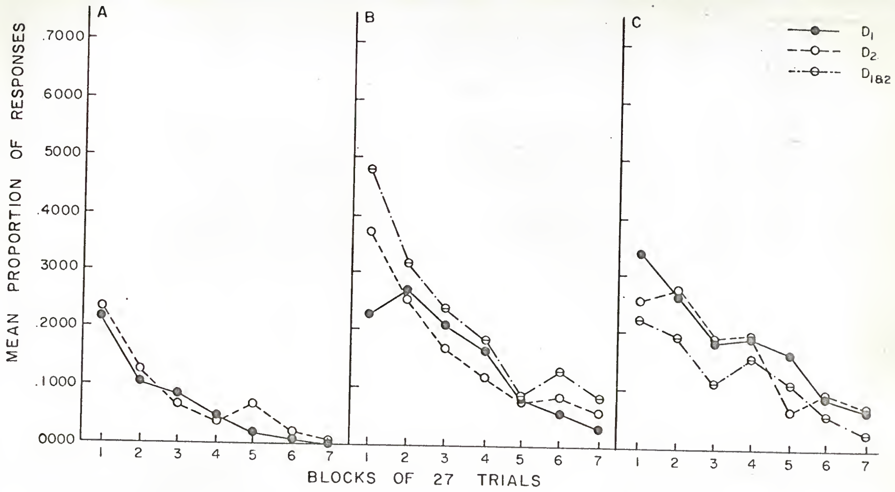

Figure 12. Mean proportion of D_1-, D_2-, and $D_{1\&2}$-responses under .00 ROI for (A) .00 PTI, (B) .33 PTI, and (C) .67 PTI.

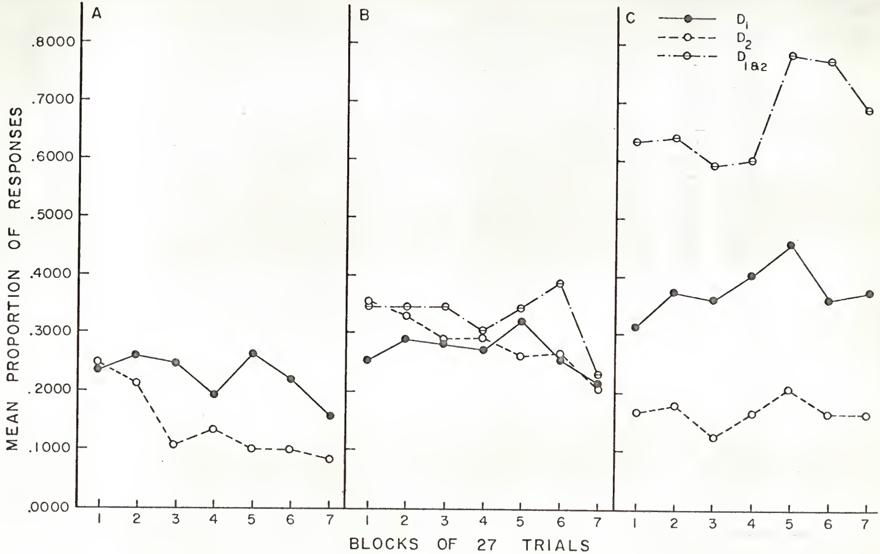

Figure 13. Mean proportion of D_1-, D_2-, and $D_{1\&2}$-responses under .33 ROI for (A) .00 PTI, (B) .33 PTI, and (C) .67 PTI.

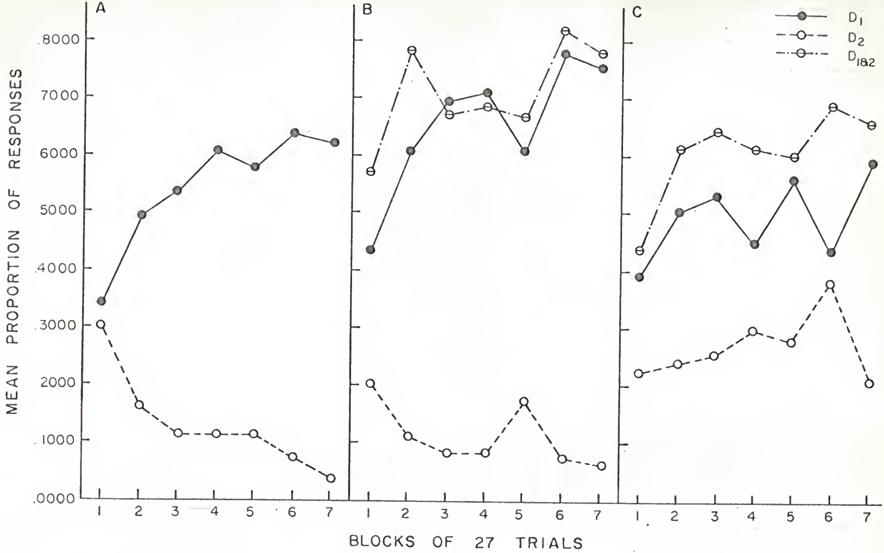

Figure 14. Mean proportion of D_1-, D_2-, and $D_{1\&2}$-responses under .67 ROI for (A) .00 PTI, (b) .33 PTI, and (C) .67 PTI.

For the .67 x .67 group, the proportions of the three responses are in the same relative position as they were for the .33 x .67 group, although not so widely separated.

Goodness-of-fit of theoretical curves

A statistic suggested as an appropriate one to test the goodness-of-fit of a probability learning experiment on imitation is the Pearson χ^2 (Bush and Mosteller, 1955). Table 12 gives the χ^2s computed for the curves fitted to the data of Figures 3B, 4A, B, C, 6A, 7A, B, C, 9B, 10A, B, and C.

Of the 33 χ^2s computed, 11 are significant ($p \leq .05$) - that is, in exactly one-third of the cases there is a significant discrepancy between the values predicted by the model and the observed points. Despite this, the overall fit proves to be adequate (χ^2=351.92, df=161, $p > .05$).[2] Thus, while the model falls short of predicting the details accurately, it is still useful in describing the overall shape of the data. In general, where the Trial Block to Trial Block variation is great, the model proves to be less accurate than where such variation is small.

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[2] $\chi^2_{.05,161}$ =381.58

TABLE 12

PEARSON χ^2S FOR GOODNESS-OF-FIT OF THEORETICAL CURVES TO OBSERVED POINTS. df=5, EXCEPT AS NOTED.

Response	ROI	PTI	Figure	χ^2	p
D_1	.00	ALL	3B	7.35	
	.33	ALL		14.06	<.025
	.67	ALL		9.89	
	.00	.00	4A	3.96*	
		.33	B	19.06	<.005
		.67	C	1.82	
	.33	.00	A	8.57	
		.33	B	7.24	
		.67	C	3.22	
	.67	.00	A	3.10	
		.33	B	16.78	<.005
		.67	C	8.31	
D_2	ALL	.00	6A	22.32	<.001
	ALL	.33		4.24	
	ALL	.67		7.92	
	.00	.00	7A	14.73**	<.01
		.33		2.11	
		.67		5.86	
	.33	.00	7B	7.52	
		.33		1.20	
		.67		1.84	
	.67	.00	7C	13.35	<.025
		.33		64.21	<.001
		.67		6.35	
$D_{1\&2}$	.00	ALL	9B	2.80	
	.33	ALL		14.30	<.025
	.67	ALL		24.70	<.001
	.00	.33	10A	2.91**	
		.67		10.01	
	.33	.33	10B	5.02	
		.67		31.29	<.001
	.67	.33	10C	10.69	
		.67		15.19	<.01
OVERALL	ALL	ALL	ALL	351.92***	

*df=3

**df=4

***df=161

CHAPTER IV

DISCUSSION: EXPERIMENT I

The data presented offer strong substantiation of the hypothesis that the levels of simple, imitative responses are affected by reinforcement in much the same way as are other response categories. Furthermore, the course of acquisition and extinction of imitative responses can be fairly accurately described by the Estes and Straughan (1954) model.

These results differ, with few exceptions (Miller & Dollard, 1941; Asch, 1952; Solomon & Coles, 1954), from most of the studies cited earlier (Luchins, 1944; Schein, 1954; Bush & Mosteller, 1955; Kanareff & Lanzetta, 1958, 1960; Lanzetta & Kanareff, 1959, 1961; Neimark & Rosenberg, 1959) which, using a variety of experimental manipulations, failed to produce the expected levels of imitation. It is plausible to argue that earlier negative experiences with imitation (as in cheating) exercise a suppressive influence on such behavior in the experimental setting. But it can be argued with equal plausibility, as Miller and Dollard (1941) do argue, that earlier learning of imitative behavior should have a facilitative effect in these situations.

For any given _S_, the issue becomes one of determining whether negative or positive experience with imitation predominates in that _S_'s earlier life. Predictions about the likelihood of imitation could then be made accordingly. Lacking such empirical determination and

in the absence of theoretical justification, asserting the existence of an inhibitory or facilitative process is, at best, speculative.

What then can be advanced to account for the low level of imitation observed in some of these studies? How do they differ from those studies in which imitative behavior does reach predicted levels? Putting the question in another way, if the Miller and Dollard (1941) drive-cue-response-reward analysis of the learning of imitative behavior is correct, in what way do the studies in which only limited levels of imitative behavior were produced depart from the model?

One area of difference that becomes immediately apparent is cue reliability. Whereas the studies that closely follow the Miller and Dollard procedure provided a completely reliable cue in the leader's behavior, the cue of the leader's behavior in most of the other studies varied in reliability between 0 and 1.00 depending on the rate of reinforcement.

Two arguments, one empirical, the other theoretical, militate against considering cue unreliability as the source of inhibition of imitation. Empirically, Neimark and Rosenberg (1959) have demonstrated that cue unreliability of itself does not affect the asymptotic rate of responding except when the cue is associated with a social source. From a theoretical point of view, the predicted rate of responding in the probability learning situation takes into account cue reliability, in that, response rate is considered as a function of reinforcement rate. In the absence of theoretical considerations leading to a different expectation when the cue is attributed to a social origin, cue unreliability cannot be held to have an adverse effect on imitation levels.

The second factor to be considered is that a different class of imitation responses was involved in the studies failing to show predicted levels of imitation. The Miller and Dollard (1941) procedure involved a response of actually following the leader by the imitator, so that both made essentially the same response - running to the same arm of the T-maze or walking to the same corner of the room. The probability learning situation, on the other hand, requires only that the imitator's response have the same outcome as the leader's - i.e., that the imitator indicate, by whatever response he selects or is directed to make, which of a number of alternatives is correct on a given trial. The actual response he makes does not have to be and, most often, is not the same as the leader's response, nor is it necessarily the same response on successive trials.

Again, the absence of theoretical justification argues against the expectation of a differential effect arising from this source. Moreover, the successful prediction of the levels of a variety of responses in the probability learning situation (e.g., Bush & Mosteller, 1955; Hilgard, 1956; Estes, 1957; Bush, 1960) urges strongly the rejection of the hypothesis that it is the difference in response class which had an unpredictable inhibitory effect on imitation.

Still to be considered are differences in drive and reward. Since a drive-reduction model is under examination, these two components may best be dealt with together.

In the Miller and Dollard (1941) study, drive originates in hunger or a hunger derived state, appetite for candy. Reward consists of food or candy, objects appropriate for drive reduction. The drive

and reward present in the studies using a verbal conditioning paradigm are not so easily pinpointed. To say in such situations that secondary reinforcement operates to reduce acquired drive may well be correct. But it is then necessary to specify the source of drive, and the nature and relation of reinforcement to it need to be delineated.

In another context, Brown (1953) has dealt cogently with this problem. He suggests that the motivating component of acquired drive may consist of a learned tendency toward anxiety in the absence of some coveted object or state (e.g., money, prestige). Anxiety, as drive, energizes behavior which is directed by stimuli toward acquiring the object. Attainment of the goal reduces anxiety and the anxiety reduction is concomitantly reinforcing.

Brown's argument can readily be extended to account for an inhibitory process occurring in the presence of some offensive object. The anxiety aroused by the object energizes avoidance behavior. At the same time, responses which led to the object are inhibited. The consequent anxiety reduction reinforces both the behavior leading away from the object and inhibits responses leading to it.

It can be said that not being right is anxiety provoking and that being right is anxiety reducing. In the course of the usual verbal conditioning experiment, responses associated with being right are reinforced while responses associated with not being right are inhibited. But since _S_s do not know in advance which response will be correct, the result is a compromise in the form of the probability matching.

When reinforcement (being right) is contingent on imitation, however, a more complex situation obtains.

In the past, some responses of imitation or agreement with others can be said to have reduced the anxiety that occurs in the presence of the behavior of others. As to the source of this anxiety, it has already been noted that imitation pervades social interactions beginning in early childhood. Not doing what others do or being in disagreement with others has often led to the withholding of approval or to ridicule and, thus, to a state of anxiety. (The fact that approval and ridicule themselves may be secondary reinforcers does not matter, so long as they have the functional properties of reinforcers.) The anxiety thus generated acts as a drive which energizes responses leading to imitation. Successful imitation reduces the anxiety and the anxiety reduction, in turn, reinforces the responses leading to imitation.

(Empirical support for the thesis that conforming to the behavior of others may be anxiety reducing is found in studies by Hoffman (1957) and Bogdonoff, Klein, Estes, Shaw, and Back (1961). In the Bogdonoff, _et al._, study, all _S_s who participated in a conformity study showed an increase in the plasma-free fatty acid level (FFA), an effect the authors identify as "an index of central nervous system arousal." However, _S_s with high conformity scores showed reduction in the FFA level as measured sequentially in the course of the experiment. Low conformity _S_s, on the other hand, continued to show high FFA levels throughout.)

(Hoffman used the GSR to measure anxiety with _S_s immediately after they expressed agreement or disagreement with bogus group norms on social attitudes. _S_s who changed previously disagreement-responses to agreement with the "norms" showed only a small increase in GSR. _S_s who continued in their disagreement showed a considerable increase in GSR scores.)

(The earlier comparison of conformity to imitation is pertinent here as well. In imitation studies, the fact that only one or, at most as in this study, two models are present, may have the effect that the level of anxiety induced is lower than in the usual conformity study. However, the position taken here is that some amount of anxiety is generated in imitation studies in a way that is analogous to the effect reported by Bogdonoff, et al., and Hoffman in their conformity studies.)

However, not all past experience with imitation is likely to have been associated with anxiety reduction. Quite the contrary, imitation in the form of cheating, for example, may have led instead to anxiety arousal and thus to the inhibition of responses leading to imitation. Situations involving anxiety can therefore be expected to inhibit imitative responses.

Just such is the case in the verbal conditioning experiment. Since not all imitative responses are reinforced, some amount of anxiety is generated on trials for which imitation is not the correct response. In the past, there has been a learned tendency to inhibit imitative responses in the presence of anxiety. Accordingly, the proportion of imitative responses can be expected to be lower than that predicted by the matching law, as was found to be the case in the studies cited.

The question then remains, why did not the anxiety generated by not being right reduce the level of imitation in this study? One important difference between this study and earlier studies is immediately apparent. The other studies provided S with only one model to be imitated, whereas in this study, there were two models. It is possible that the presence of the second model served to differentiate this

experimental situation from imitation-with-anxiety situations. Thus, although some anxiety was generated on non-reinforced trials, there was a sufficient dissimilarity with other imitation-with-anxiety situations so that the inhibitory process postulated to occur in such situations was not activated. In the absence of an inhibitory process the level of imitative responses could well be governed by the rate of reinforcement so that probability matching could occur.

As another consequence of the absence of an inhibitory process, the drive inducing properties of the behavior of others, as suggested above, should be increased when the proportion of agreement between the two models-to-be-imitated is increased. In general, this appears to be the case. First, the D_1-, D_2-, and $D_{1\&2}$-responses tend to increase with increasing PTI and constant ROI rates. Secondly, the proportion of $D_{1\&2}$-responses generally increases more than the proportion of D_1-responses as PTI is increased.

The latter outcome should occur with increased drive level provided that the initial habit ($_sH_r$) of the $D_{1\&2}$-response is greater than that of the D_1-response (Hull, 1952). That such is the case is evident from an analysis of first trial responses when $D_{1\&2}$-responses were possible and when they were not. When D_1 and D_2 choices coincided on the first Trial, 75 per cent of the responses were imitative. When the D_1 and D_2 choices did not coincide, only 42 per cent of the responses were imitative of <u>either</u> D_1 or D_2. The difference was significant (χ^2=5.85, df=1, p<.02). Starting with a difference in habit strength between D_1- and $D_{1\&2}$-imitative responses, the higher drive level occasioned by an increase in the rate of agreement between D_1 and D_2 resulted in

an increase in proportion of $D_{1\&2}$-responses which was greater than the increase in proportion of D_1-responses.

If this analysis is correct - that is, if the increase in agreement between D_1 and D_2 affects drive level, then changing the rate of agreement between D_1 and D_2 after a stable level of responding has been reached should have the same effect as changing any drive level. It has been demonstrated (Horenstein, 1951; Campbell & Kraeling, 1953; Cotton, 1953; Hillman, Hunter, & Kimble, 1953; Spence, 1956) that changes in drive level will change performance proportionally. It would be expected, therefore, that increasing the range of agreement between D_1 and D_2 after an initially low rate of agreement between them should result in an increased proportion of imitation. Decreasing the rate of agreement between D_1 and D_2 after an initially high rate of agreement should have the opposite effect. Furthermore, since there are two responses of different strength involved, it would be expected that the response of higher strength would be more affected by the change.

A second experiment was performed to test these predictions.

CHAPTER V

METHOD: EXPERIMENT II

Experimental design

Two values of ROI and PTI (.33 and .67) were varied independently in the first Series of five Blocks of 27 Trials of the experiment. In the second Series, PTI was systematically varied so that it remained the same as in the first Series or took on the second value. ROI remained the same as in the first Series. Table 13 diagrams the design.

TABLE 13

EXPERIMENTAL DESIGN IN TERMS OF ROI AND PTI RATES IN THE TWO PHASES OF THE EXPERIMENT.

Series 1 Trials 1-135		Series 2 Trials 136-270	
ROI	PTI	ROI	PTI
.33	.33	.33	.33
.33	.33	.33	.67
.33	.67	.33	.67
.33	.67	.33	.33
.67	.33	.67	.33
.67	.33	.67	.67
.67	.67	.67	.67
.67	.67	.67	.33

Subjects

The Ss were 64 University of Florida students drawn one year later from the same two introductory Psychology courses as in Experiment I. They were randomly assigned in groups of four to the eight conditions of the experiment, one sub-group of four males and one sub-group of two males and two females to each group.

Apparatus

The apparatus was substantially the same as in Experiment I, although located in a different place.

Procedure

The procedure for Series 1 was the same as for the four similar ROI x PTI groups in Experiment I. Following immediately after Series 1, Trials 136 to 270 were given. For groups with no change in PTI, the additional Trials consisted of a repetition of Trials 1 to 135. For groups with a change in PTI, the additional Trials were the same as Trials 1 to 135 of groups receiving that particular combination of ROI x PTI.

CHAPTER VI

RESULTS: EXPERIMENT II

The response categories analyzed in Experiment I - that is, the mean proportion of D_1-, D_2-, and $D_{1\&2}$- responses - were analyzed here.

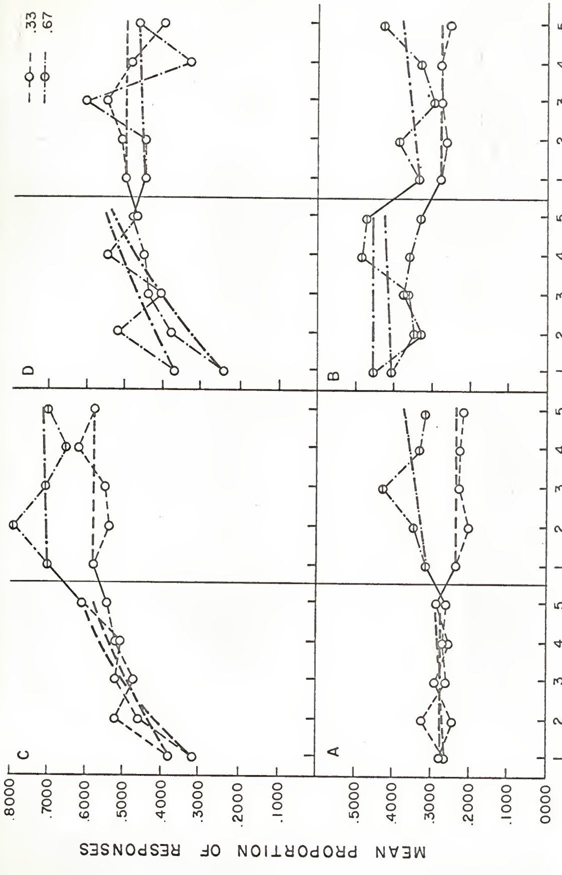
There was also an attempt made to fit theoretical curves to the observed points using θ values computed for the five-Trial Blocks of Series 1 and Series 2 by Equations (1) and (2) cited above.

Figures 15, 16, and 17 summarize the results of Experiment II as the mean proportions of D_1-, D_2-, and $D_{1\&2}$-responses, respectively, for Blocks of 27 Trials in two Series of five Blocks each, under the two ROI and four PTI combinations used. Panel-pair A of each figure shows the performance of two groups of eight Ss each, under .33 ROI. One group had received .33 PTI in both Series 1 and 2, while the other group had gotten .33 PTI in Series 1 and .67 PTI in Series 2. Panel-pair B shows the performance of two other groups under .33 ROI who had started with .67 PTI in Series 1. One group had been continued with .67 PTI while the other group had been switched to .33 PTI in Series 2. Panel-pairs C and D show the data for the two remaining pairs of groups which had been given .67 ROI and had the same PTI conditions as above. Smoothed curves, generated by Equations (1) and (2) cited above, have been fitted to the data and are evaluated in a later section.

The analysis of variance of these data for the mixed factorial design with repeated measurements on three factors is presented in

Figure 15. Mean proportion of D_1-responses for conditions as shown in tabular form below for five 27-Trial Blocks in each of two Series. Each panel-pair shows the performance of two groups with the same PTI rate in Series 1 and different PTI rates in Series 2.

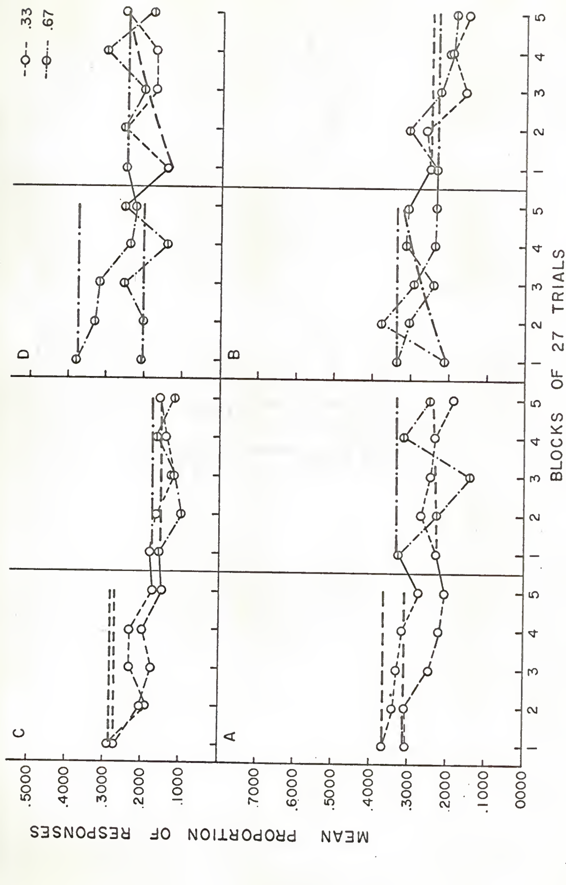
Panel Pair	ROI	PTI Series 1	PTI Series 2
A	.33	.33	.33 .67
B	.33	.67	.67 .33
C	.67	.67	.67 .33
D	.67	.33	.33 .67



C
D
A
B
.33
.67
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.5000
.4000
.3000
.2000
.1000
.0000
1 2 3 4 5 1 2 3 4 5
1 2 3 4 5 1 2 3 4 5
BLOCKS OF 27 TRIALS
MEAN PROPORTION OF RESPONSES

Figure 16. Mean proportion of D_2-responses for conditions as shown in tabular form below for five 27-Trial Blocks in each of two Series. Each panel pair shows the performance of two groups with the same PTI rate in Series 1 and different PTI rates in Series 2.

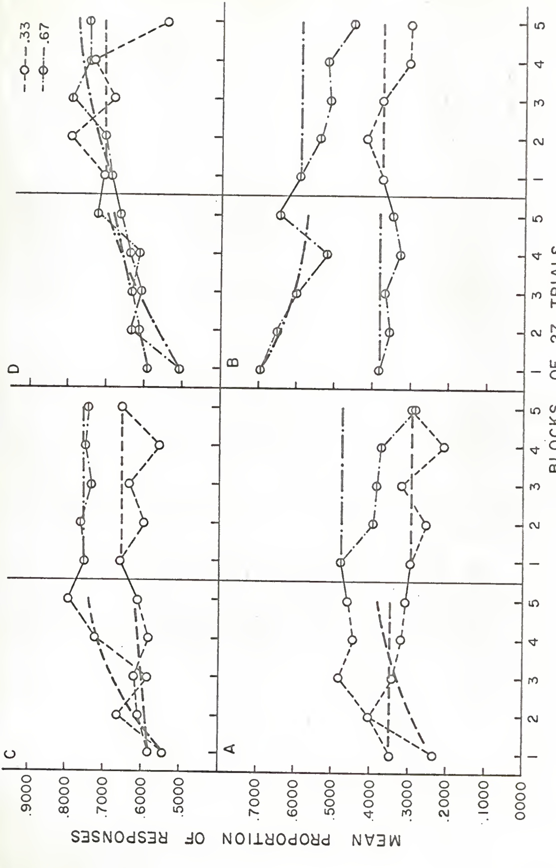
Panel Pair	ROI	PTI Series 1	PTI Series 2
A	.33	.33	.33 .67
B	.33	.67	.67 .33
C	.67	.67	.67 .33
D	.67	.33	.33 .67



A
B
C
D
.33
.67
BLOCKS OF 27 TRIALS
MEAN PROPORTION OF RESPONSES
.5000
.4000
.3000
.2000
.1000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
1
2
3
4
5

Figure 17. Mean proportion of $D_{1\&2}$-responses for conditions as shown in tabular form below for five 27-Trial Blocks in each of two Series. Each panel pair shows the performance of two groups with the same PTI rate in Series 1 and different PTI rates in Series 2.

Panel Pair	ROI	PTI Series 1	PTI Series 2
A	.33	.33	.33 .67
B	.33	.67	.67 .33
C	.67	.67	.67 .33
D	.67	.33	.33 .67



C
D
A
B
.33
.67
.9000
.8000
.7000
.6000
.5000
.4000
.3000
.2000
.1000
.0000
1
2
3
4
5
BLOCKS OF 27 TRIALS
MEAN PROPORTION OF RESPONSES

Table 14. For clarity, only terms for significant effects, for error, and for totals are shown separately. The remaining variance is shown as Residual Non-significant Between Effects and Residual Non-significant Within Effects.

All the significant effects appear as simple effects of the two significant higher order interactions, S x R x PTI and T x S x R x ROI. Accordingly, it is these interactions that were selected for further analysis.

The T x S x R x ROI interaction

Figures 18A, B, and C show the relationships of the means entering into the T x S x R x ROI interaction. The means represent the ROI effect on the five Trial Blocks in Series 1 and 2 for each of the three response categories. Involved in the analysis are comparisons among 30 means at each of two ROI levels, quite a cumbersome and far too detailed a procedure for the purpose.

To simplify the presentation, comparisons were restricted to within response categories. Justification for this was found in an examination of the curves of Figures 18A, B, and C which suggested that the effects were clearly different for the three responses. To have made inter-response comparisons would, therefore, have made the presentation needlessly complex.

As a further simplification, separate comparisons were made of Trial Blocks within ROI levels and within and across Series, and of Trial Blocks across ROI levels and within Series. The Newman-Keuls method of the q-range statistic for differences among ordered means (Winer, 1962) was used to determine significance levels.

TABLE 14

ANALYSIS OF VARIANCE OF THE PROPORTION OF D_1-, D_2-, AND $D_{1\&2}$-IMITATIVE RESPONSES FOR EXPERIMENT II.

Source	df	MS	F	p
Between Ss	63	26.5635*		
ROI	1	8.3864	30.4248	<.001
Error (b)	56	.2756		
Residual Non-significant Between Effects (2)	6	2.7411*		
Within Ss	1856	107.6139*		
Trials (T) x ROI	4	.0586	3.5427	<.01
Error (w_1)	224	.0165		
Series (S) x ROI	1	.8898	15.5907	<.001
Error (w_2)	56	.0571		
Responses (R)	2	15.0397	72.8043	<.001
R x ROI	2	4.3769	21.1876	<.001
Error (w_3)	112	.2066		
T x S	4	.0633	2.8589	<.025
Error (w_4)	224	.0221		
T x R	8	.0540	2.2997	<.005
Error (w_5)	448	.2035		
S x R	2	.3522	10.0352	<.001
S x R x ROI	2	.1993	5.6778	<.005
S x R x PTI	6	.1012	2.8836	<.025
Error (w_6)	112	.0351		
T x S x R	8	.0611	3.4914	<.001
T x S x R x ROI	8	.0412	2.3543	<.025
Error (w_7)	448	.0175		
Residual Non-significant Within Effects (17)	185	7.1900*		
Total	1919	134.1774*		

*Sum of SS rather than MS

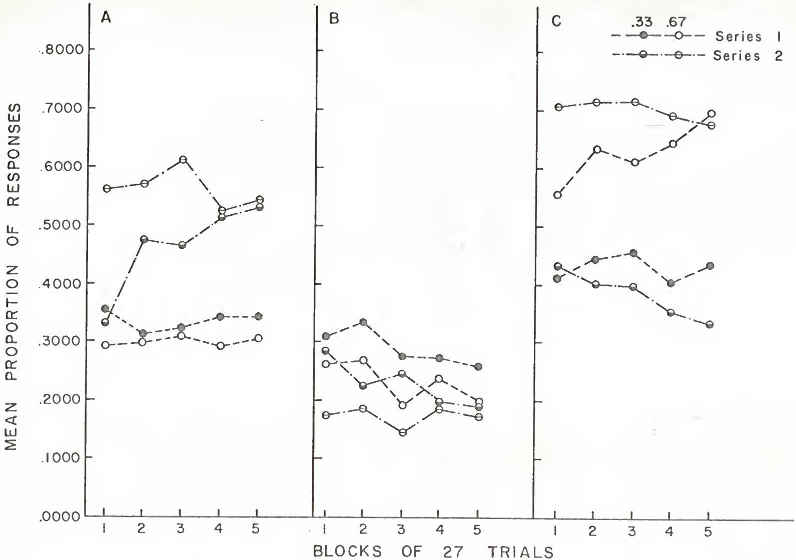


Figure 18. Mean proportion of responses for five 27-Trial Blocks in each of two Series for ROI=.33 and .67 of (A) D_1-responses, (B) D_2-responses, and (C) $D_{1\&2}$-responses.

Table 15 shows the comparison of means for D_1-responses under .33 ROI for each of five Trial Blocks in two Series. There are no

TABLE 15

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_1-RESPONSES FOR T X S X R X ROI WITHIN ROI=.33. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series			1				2				
	Trial Block		2	3	4	5	1	2	3	4	5
		Mean	31	32	34	34	33	48	47	51	53
1	1	35	-04	-03	-01	-01	-02	<u>13</u>	<u>12</u>	<u>16</u>	-<u>18</u>
	2	31		01	03	03	02	<u>17</u>	<u>16</u>	<u>20</u>	<u>22</u>
	3	32			02	02	01	<u>16</u>	15	<u>19</u>	<u>21</u>
	4	34				00	-01	<u>14</u>	<u>13</u>	17	<u>19</u>
	5	34					-01	<u>14</u>	<u>13</u>	<u>17</u>	<u>19</u>
2	1	33						<u>15</u>	<u>14</u>	<u>18</u>	<u>20</u>
	2	48							-01	03	05
	3	47								04	06
	4	51									02

significant differences among Trial Blocks of Series 1. Nor does Trial Block 1 of Series 2 differ significantly from Series 1 Trial Blocks. On the other hand, all Trial Blocks of Series 1 and Trial Block 1 of Series 2 are significantly lower than the rest of Series 2 Trial Blocks. Finally, except for Trial Block 1, Trial Blocks of Series 2 do not differ significantly among themselves.

Table 16 shows the same comparisons for .67 ROI. There are no significant differences among Trial Blocks either within Series 1 or Series 2. However, all Trial Blocks of Series 1 are significantly lower than all Trial Blocks of Series 2.

TABLE 16

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_1-RESPONSES FOR T X S X R X ROI WITHIN ROI=.67. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	Trial Block	Mean	1				2				
			2	3	4	5	1	2	3	4	5
		Mean	30	32	30	31	56	58	61	53	54
1	1	29	01	03	01	02	$\underline{27}$	$\underline{29}$	$\underline{32}$	$\underline{24}$	$\underline{25}$
	2	30		02	00	01	$\underline{26}$	$\underline{28}$	$\underline{31}$	$\underline{23}$	$\underline{24}$
	3	32			-02	-01	$\underline{24}$	$\underline{26}$	$\underline{29}$	$\underline{21}$	$\underline{22}$
	4	30				01	$\underline{26}$	$\underline{28}$	$\underline{31}$	$\underline{23}$	$\underline{24}$
	5	31					$\underline{25}$	$\underline{27}$	$\underline{30}$	$\underline{22}$	$\underline{23}$
2	1	56						02	05	-03	-02
	2	58							03	-05	-04
	3	61								-08	-07
	4	53									01

TABLE 17

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_1-RESPONSES FOR T X S X R X ROI AT TWO LEVELS OF ROI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

ROI	Series	Trial Block	Mean	67									
				1					2				
				1	2	3	4	5	1	2	3	4	5
			Mean	29	30	32	30	31	56	58	61	53	54
33	1	1	35	-06	-05	-03	-05	-04					
		2	31	-02	-01	01	-01	00					
		3	32	-03	-02	00	-02	-01					
		4	34	-05	-04	-02	-04	-03					
		5	34	-05	-04	-02	-04	-03					
	2	1	33						$\underline{23}$	$\underline{25}$	$\underline{28}$	$\underline{20}$	$\underline{21}$
		2	48						08	$\underline{10}$	$\underline{13}$	05	06
		3	47						$\underline{09}$	$\underline{11}$	$\underline{14}$	06	07
		4	51						05	07	$\underline{10}$	02	03
		5	53						03	05	08	00	01

Table 17 presents the comparisons of Trial Blocks within Series across ROI levels. Trial Blocks of Series 1 under .33 ROI do not differ significantly from Trial Blocks of Series 1 under .67 ROI. In 11 of the 25 comparisons, Trial Blocks of Series 2 under .67 ROI are significantly higher than Trial Blocks of Series 2 under .33 ROI.

Tables 18, 19, and 20 present the same comparisons for D_2-responses. Few of the differences are significant (18 out of 140 comparisons) so that essentially D_2-responses did not seem to be affected by ROI levels.

TABLE 18

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES FOR T X S X R X ROI WITHIN ROI=.33. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	Trial Block		1				2				
			2	3	4	5	1	2	3	4	5
		Mean	33	28	27	26	29	23	24	20	20
1	1	31	02	-03	-04	-05	-02	-08	-07	-11	-11
	2	33		-05	-06	-07	-04	-10	-09	-13	-13
	3	28			-01	-02	01	-05	-04	-08	-08
	4	27				-01	02	-04	-03	-07	-07
	5	26					03	-03	-02	-06	-06
2	1	29						-06	-05	-09	-09
	2	23							01	-03	-03
	3	24								-04	-04
	4	20									00

TABLE 19

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES FOR T X S X R X ROI WITHIN ROI=.67. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	Trial Block	Mean	1				2				
			2	3	4	5	1	2	3	4	5
		Mean	27	19	24	19	18	19	15	20	17
1	1	26	01	-07	-02	-07	-08	-07	$-\underline{11}$	-06	$-\underline{09}$
	2	27		-08	-03	-08	$-\underline{09}$	-08	$-\underline{12}$	-07	$-\underline{10}$
	3	19			05	00	-01	00	-04	01	-02
	4	24				-05	-06	-05	-09	-04	-07
	5	19					-01	00	-04	01	-02
2	1	18						01	-03	02	-01
	2	19							-04	-05	-02
	3	15								05	02
	4	20									-03

TABLE 20

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES FOR T X S X R X ROI FORTWO LEVELS OF ROI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

ROI	Series	Trial Block	Mean	67									
				1					2				
				1	2	3	4	5	1	2	3	4	5
			Mean	26	27	19	24	19	18	19	15	20	17
33	1	1	31	-05	-04	$-\underline{12}$	-07	$-\underline{12}$					
		2	33	-07	-06	$-\underline{14}$	-09	$-\underline{14}$					
		3	28	-02	-01	-09	-04	-09					
		4	27	-01	00	-08	-03	-08					
		5	26	00	01	-07	-02	-07					
	2	1	29						$-\underline{11}$	$-\underline{10}$	$-\underline{14}$	-09	$-\underline{12}$
		2	23						-05	-04	-08	-03	-06
		3	24						-06	-05	-09	-04	-07
		4	20						-02	-01	-05	00	-03
		5	20						-02	-01	-05	00	-03

TABLE 21

DIFFERENCES BETWEEN MEAN PROPORTIONS OF $D_{1\&2}$-RESPONSES FOR T X S X R X ROI WITHIN ROI=.33. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p\leq.05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	Trial Block	Mean	1				2				
			2	3	4	5	1	2	3	4	5
		Mean	40	40	35	33	70	72	71	70	67
1	1	43	-03	-03	-08	-10	27	29	28	27	24
	2	40		00	-05	-07	30	32	31	30	27
	3	40			-05	-07	30	32	31	30	27
	4	35				-02	35	37	36	35	32
	5	33					37	39	38	37	34
2	1	70						02	01	00	-03
	2	72							-01	-02	-05
	3	71								-01	-04
	4	70									-03

TABLE 22

DIFFERENCES BETWEEN MEAN PROPORTIONS OF $D_{1\&2}$-RESPONSES FOR T X S X R X ROI WITHIN ROI=.67. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p\leq.05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	Trial Block	Mean	1				2				
			2	3	4	5	1	2	3	4	5
		Mean	45	45	40	44	56	63	61	64	70
1	1	41	04	04	-01	03	15	22	20	23	29
	2	45		00	-05	-01	11	18	16	19	25
	3	45			-05	-01	11	18	16	19	25
	4	40				04	16	23	21	24	30
	5	44					12	19	17	20	26
2	1	56						07	05	08	14
	2	63							-02	01	07
	3	61								03	09
	4	64									06

Table 21 shows the comparisons of means for $D_{1\&2}$-responses under .33 ROI among Trial Blocks within and across Series. For the most part, Trial Blocks within Series do not differ significantly (two out of 20 comparisons). However, Series 2 Trial Blocks are significantly higher than Series 1 Trial Blocks.

Table 22 shows the same comparisons for the .67 ROI condition. Again, few significant differences are seen within Series (three out of 20 comparisons), and Trial Blocks of Series 2 are significantly higher than Trial Blocks of Series 1.

Table 23 compares Trial Blocks within Series, across ROI conditions. Seven of the 25 comparisons within Series 1 show significantly

TABLE 23

DIFFERENCES BETWEEN MEAN PROPORTIONS OF $D_{1\&2}$-RESPONSES FOR T X S X R X ROI AT TWO LEVELS OF ROI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

ROI				67									
	Series			1					2				
		Trial Block		1	2	3	4	5	1	2	3	4	5
			Mean	41	45	45	40	44	56	63	61	64	70
33	1	1	43	-02	02	02	-03	01					
		2	40	01	05	05	00	04					
		3	40	01	05	05	00	04					
		4	35	06	$\underline{10}$	$\underline{10}$	05	$\underline{09}$					
		5	33	$\underline{08}$	$\underline{12}$	$\underline{12}$	07	$\underline{11}$					
	2	1	70						$\underline{-14}$	-07	$\underline{-09}$	-06	00
		2	72						$\underline{-16}$	$\underline{-09}$	$\underline{-11}$	-08	-02
		3	71						$\underline{-15}$	-08	$\underline{-10}$	-07	-01
		4	70						$\underline{-14}$	-07	$\underline{-09}$	-06	00
		5	67						$\underline{-11}$	-04	-06	-03	03

higher means under .67 ROI. In Series 2, on the other hand, ten of the 25 comparisons show significantly higher means for the .33 ROI condition.

To summarize the comparisons thus far described:

For D_1-responses, there are generally no significant differences among Trial Blocks within Series under either .33 or .67 ROI. Trial Blocks of Series 1 are in most instances significantly lower than Trial Blocks of Series 2 under both ROI conditions. No significant differences are seen between Trial Blocks of Series 1 under .33 ROI when compared to Trial Blocks of Series 1 under .67 ROI. Some Trial Blocks of Series 2 under .67 ROI show significantly higher means than under .33 ROI.

For D_2-responses, few significant differences occur in any of the comparisons made.

For $D_{1\&2}$-responses, differences within ROI levels are similar to those found in comparisons within D_1-responses. However, some Series 1 Trial Blocks are significantly higher while some Series 2 Trial Blocks are significantly lower under .67 ROI than under .33 ROI.

The S x R x PTI interaction

Figures 19A, B, and C show the relationships among the 24 means entering into the S x R x PTI interaction. Examination of the curves indicates that the D_2-response means are considerably below the D_1- and $D_{1\&2}$-response means. Table 24, comparing the means within the D_2-responses, shows only two of the 28 differences to be significant by the _q_-range statistic. Thus changes in PTI did not affect the level of D_2-responses to any great extent.

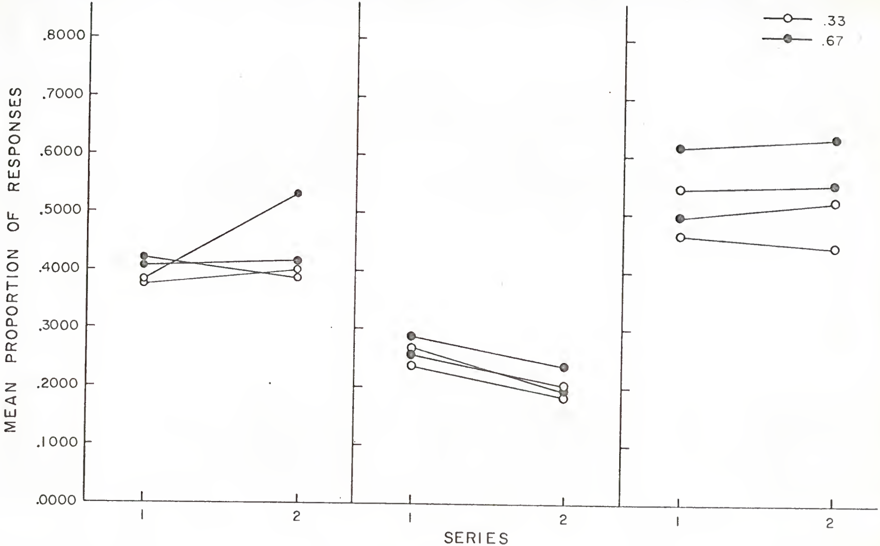


Figure 19. Mean proportion of responses in two Series under PTI=.33 and .67 in both Series, PTI=.33 and .67 in Series 1, and PTI=.67 and .33 in Series 2 for (A) D_1-responses, (B) D_2-responses, and (C) $D_{1\&2}$-responses.

TABLE 24

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_2-RESPONSES FOR S X R X PTI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p\leq.05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series	PTI*	PTI**								
Series				1			2			
	PTI*			33	67	67	33	33	67	67
		PTI**		67	67	33	33	67	67	33
			Mean	26	28	25	19	19	23	20
1	33	33	24	02	04	01	-05	-05	-01	-04
	33	67	26		02	-01	-07	-07	-03	-06
	67	67	28			-03	$\underline{-09}$	$\underline{-09}$	-05	-08
	67	33	25				-06	-06	-02	-05
2	33	33	19					00	-04	-01
	33	67	19						-04	-01
	67	67	23							-03

*Rate in Series 1

**Rate in Series 2

Table 25 compares the S x R x PTI means within D_1-responses. Increasing the rate of PTI from .33 in Series 1 to .67 in Series 2 increased the rate of responding significantly. However, changing PTI from .67 in Series 1 to .33 in Series 2 or maintaining the same value of PTI in both Series did not change the level of responding.

Table 26 compares the S x R x PTI means within $D_{1\&2}$-responses. Changing the rate of PTI between Series or maintaining it constant throughout had no significant effect on the level of responding. What significant differences there are in Table 26, are between groups rather than within groups but without any systematic relationship to PTI rate.

TABLE 25

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_1-RESPONSES FOR S X R X PTI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series				1			2			
	PTI*			33	67	67	33	33	67	67
		PTI**		67	67	33	33	67	67	33
			Mean	38	41	42	40	53	41	39
1	33	33	38	00	03	04	02	$\underline{15}$	03	01
	33	67	38		03	04	02	$\underline{15}$	03	01
	67	67	41			01	-01	$\underline{12}$	00	-02
	67	33	42				-02	$\underline{11}$	-01	-03
2	33	33	40					$\underline{13}$	01	-01
	33	67	53						$-\underline{12}$	$-\underline{14}$
	67	67	41							-02

*Rate in Series 1

**Rate in Series 2

TABLE 26

DIFFERENCES BETWEEN MEAN PROPORTIONS OF $D_{1\&2}$-RESPONSES FOR S X R X PTI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Series				1			2			
	PTI*			33	67	67	33	33	67	67
		PTI**		67	67	33	33	67	67	33
			Mean	55	61	50	45	57	63	52
1	33	33	46	$\underline{09}$	$\underline{15}$	04	-01	$\underline{11}$	$\underline{17}$	06
	33	67	55		05	-05	$-\underline{10}$	02	$\underline{08}$	-03
	67	67	61			$-\underline{11}$	$-\underline{16}$	-04	02	$-\underline{09}$
	67	33	50				-05	07	$\underline{13}$	02
2	33	33	45					$\underline{12}$	$\underline{18}$	07
	33	67	57						06	-05
	67	67	63							$-\underline{11}$

*Rate in Series 1

**Rate in Series 2

Table 27 shows the comparison between means of D_1- and $D_{1\&2}$-responses within Series 1 and within Series 2. Within Series 1, all

TABLE 27

DIFFERENCES BETWEEN MEAN PROPORTIONS OF D_1- and $D_{1\&2}$-RESPONSES FOR S X R X PTI. THE DIFFERENCE IN EACH CELL IS THE COLUMN MEAN MINUS THE ROW MEAN. SIGNIFICANT DIFFERENCES ($p \leq .05$) ARE UNDERLINED. (DECIMALS OMITTED.)

Response	Series	PTI*	PTI**		$D_{1\&2}$							
					1				2			
					33	33	67	67	33	33	67	67
					33	67	67	33	33	67	67	33
				Mean	46	55	61	50	45	57	63	52
D_1	1	33	33	38	08	$\underline{17}$	$\underline{23}$	$\underline{12}$				
		33	67	38	08	$\underline{17}$	$\underline{23}$	$\underline{12}$				
		67	67	41	05	$\underline{14}$	$\underline{20}$	$\underline{09}$				
		67	33	42	04	$\underline{13}$	$\underline{19}$	$\underline{08}$				
	2	33	33	40					05	$\underline{17}$	$\underline{23}$	$\underline{12}$
		33	67	53					$\underline{-08}$	04	$\underline{10}$	-01
		67	67	41					04	$\underline{16}$	$\underline{22}$	$\underline{11}$
		67	33	39					06	$\underline{18}$	$\underline{24}$	$\underline{13}$

*Rate in Series 1

**Rate in Series 2

$D_{1\&2}$-response means were higher than D_1-response means and, except for the groups which received .33 PTI in both Series, the differences were significant. Within Series 2, the pattern of significant differences is not readily interpretable. Given the significantly different levels of D_1- and $D_{1\&2}$-responses in Series 1, the differences in Series 2 may be a function of the different starting rates, of the changes in PTI rates, or of both. However, it is clear that the increase in the

D_1-response level under the condition in which PTI increased from .33 in Series 1 to .67 in Series 2 was sufficiently large to approximate the $D_{1\&2}$-response level in Series 2.

To summarize the analysis of the S x R x PTI interaction:

D_1-responses increased significantly when PTI was changed from the .33 rate in Series 1 to the .67 rate in Series 2. The increase was sufficient to overcome the significantly lower starting rate as compared to the $D_{1\&2}$-responses under the same PTI conditions. No other significant differences in D_1-response levels were noted.

D_2-responses were not affected significantly by changes in PTI.

$D_{1\&2}$-response levels varied significantly among some groups in both Series 1 and 2 but with no apparent systematic relationship to the PTI rate.

Curve-fitting and goodness-of-fit

Table 28 presents the θ values computed for Experiment II. The values were computed separately for each five Blocks of Trials, with the ρ values adjusted by $\rho \times \omega$ as in Experiment I.

Examination of the fit of the smoothed curves to the data points shows poor correspondence between the two. Since more than one-half of the θ values listed in Table 28 are .0000, the predicted value, by Equation (1), for all Trial Blocks is performance on Trial Block 1. Thus, any Trial Block to Trial Block variation at all is a departure from the predicted value. Under the circumstances, a better straight line fit would have been accomplished using the mean of all Trial Blocks rather than the Trial Block 1 value predicted by the model.

TABLE 28

VALUES OF θ USED IN EQUATION (1) TO GENERATE THE THEORETICAL CURVES OF FIGURES 15A, B, C, D, 16A, B, C, D, 17A, B, C, AND D. (DECIMALS OMITTED.)

Response	PTI	Series	ROI			
			33		67	
			Series 2			
	Series 1		33	67	33	67
D_1	33	1	0000	0009	0066	0095
		2	0000	0027	0000	0009
	67	1	0000	0014	0040	0056
		2	0000	0022	0000	0004
D_2	33	1	0000	0000	0000	0000
		2	0002	0000	0000	0000
	67	1	0000	0038	0000	0000
		2	0000	0000	0020	0000
$D_{1\&2}$	33	1	0116	0020	0000	0173
		2	0000	0000	0000	0000
	67	1	0000	0031	0181	0062
		2	0000	0000	0000	0052

CHAPTER VII

DISCUSSION: EXPERIMENT II

The results of Experiment II provide but meager support for the interpretation of imitation as having secondary drive effects proposed in Chapter IV.

It had been hypothesized that increasing the rate of PTI after an initially low level would increase the rate of imitative responses. This was found for D_1-responses only under the .33 PTI in Series 1, .67 PTI in Series 2, condition. None of the other conditions of increased PTI rate brought about the increase in imitative responses.

The converse hypothesis, that decreasing the rate of PTI would reduce the level of imitative responding, was not supported at all.

It had also been hypothesized that the $D_{1\&2}$-response, having been shown in Experiment I to be a stronger habit than the D_1-response, would be more greatly affected by changes in the rate of PTI as a motivational variable, than would be the D_1-response. Support for this hypothesis is, at best, equivocal, since little change occurred between Series 1 and Series 2 for either response. The evaluation of the results in terms of this hypothesis is further complicated by the observation that some of the groups under the same PTI condition differed significantly from each other in the level of $D_{1\&2}$-responses in Series 1 without any apparent relationship to the PTI rate.

The finding that none of the higher order interactions including ROI x PTI were significant is also a lack of support for these hypotheses. It would have been expected that if PTI is a motivational variable, it would combine with variables involving reinforcement with differential effect. This did not occur, suggesting either that PTI is a weak effect and is masked by the stronger ROI effect or that it is not, after all, a motivational variable.

Finally, the stochastic model which served fairly well to describe the results of Experiment I was, for the most part, an inadequate fit to the results of Experiment II.

A procedural difference between the two experiments that is immediately apparent is the number of Trial Blocks under the same ROI x PTI conditions in each. Whereas in Experiment I there were seven 27-Trial Blocks under each ROI x PTI combination, in Experiment II the ROI x PTI combination was, for half the groups, changed after five 27-Trial Blocks. In addition, curve-fitting in Experiment I was based on all seven Blocks. In Experiment II, because the ten Trial Blocks were broken into two Series of five Blocks, only five Blocks were used. This was so even where the same ROI x PTI condition was maintained throughout the two five-Block Series.

It is then possible in Experiment II, that asymptotic levels of responding had not been reached over the Trials included in Series 1. Although the difference between experiments is only two Trial Blocks, the difference is considerable when counted as individual Trials. Two Blocks represent 54 Trials out of a total of 189. Taking this difference into account, both the breakdown of the fit of the model and the lack of support for the hypotheses in Experiment II may be better understood.

The fewer number of Trial Blocks in Experiment II as compared to Experiment I may account for the poor fit of the curves generated by Equation (1). In terms of asymptotic responding as a function of the rate of reinforcement, Equation (1) predicts that as (m-1) grows larger - that is, as the number of Trial Blocks increases - the mean proportion of responses per Block will tend toward the rate of reinforcement, in this case ρ, provided that θ is large enough. From Equation (2) it can be seen that θ will approach 1.0000 when $\sum_{m=1}^{k} \overline{P}(m)$, the sum of mean proportions over Trial Blocks, becomes very large. Clearly, this will occur only over a large number of Trial Blocks.

How many Trial Blocks are needed for $\sum_{m=1}^{k} \overline{P}(m)$ to become large enough is a matter for empirical determination. In terms of the two experiments performed, the seven Trial Blocks in Experiment I gave rise to few instances of θ=.0000 and the overall fit of the curves generated by Equation (1) appeared to be adequate. On the other hand, about one-half the values in Experiment II, with five Trial Blocks, were θ=.0000, with a concomitant poor fit of the curves.

The failure to bear out the prediction that changing the PTI values would have the effects that changing the value of other motivational variables have, namely, that performance would be affected, may also be accounted for by the difference in the number of Trial Blocks in the two experiments. Such changes in performance can be separated out from learning effects only if learning is complete - i.e., that an asymptotic level of responding had been reached prior to the change in the motivational variable.

Kimble (1961), in evaluating the factorial design for separating out performance from learning variables, points out that the portion of the data which is selected for analysis is critical for the interpretation that results. His discussion concerns the analysis of a situation in which the change in performance is gradual following a shift in the value of a hypothetical motivational variable. If the analysis is made on data representing trials too soon after the shift, the influence would appear to be on both learning and performance. If the analysis is made on data from a later point past the shift, the effect would be shown to be on performance.

As applied to Experiment II, the reasoning is analogous. At the point of shifting the value of PTI, the presumed motivational variable, learning was still taking place as a function of ROI. Consequently, whatever change that might have come about as a result of the change in PTI may have been masked by the continuing, gradual but stronger effect of ROI. In terms of the analysis of variance, the amount of variance due to changes in PTI as a simple effect in interaction terms involving both ROI and PTI was far smaller than the variance due to ROI as a simple effect.

The fact that the five Trial Blocks of Experiment II did not apparently bring responding up to asymptotic levels may also account, in part, for some of the group differences found for the $D_{1\&2}$-response levels noted in Series 1. From Experiment I it is seen that the $D_{1\&2}$-response has high total mean proportions and, by implication from the discussion of Equations (1) and (2) above, high asymptotes, for three of the four ROI x PTI conditions common to both experiments. Before

reaching those asymptotes, there is a greater range of variation possible for different groups, undergoing the same ROI x PTI treatment, in the early Trial Blocks while learning is still taking place. By cutting short the number of Trial Blocks before asymptote is reached, the results reflect these possibilities of greater variation but do not include data from later, perhaps more equivalent intergroup, performance. Surprisingly, a literature search provided no direct evidence bearing on the position taken here that increasing the number of trials might have the effect of reducing differences among putatively equivalent groups undergoing the same treatment.

CHAPTER VIII

CONCLUSIONS

This study proposed to extend the Miller and Dollard (1941) formulation of imitative behavior as being acquired instrumentally, to include in the paradigm the effect of the model to be imitated. Although Miller and Dollard recognized that secondary reinforcement from extrinsic social sources was an important source for the maintenance and proliferation of imitative behavior, they seemed to have ignored entirely the possibility that the act of imitating itself may become a source of secondary reinforcement.

Others (e.g., Bush & Mosteller, 1955; Kanareff & Lanzetta, 1958; Neimark & Rosenberg, 1959) saw the act of imitating as hindering rather than advancing learning. Still others (Bandura and associates, 1961, 1962, 1963, 1963a, b, 1965, 1965a, b, c, 1966) explored imitation as a separate category of social learning with unique, social properties.

In Experiment I it was demonstrated that imitation, when interpreted as having secondary reinforcing properties, could account for the bulk of the findings. Experiment II, designed to test further the secondary reinforcement characteristics of imitation, did not support such a hypothesis. However, the failure to do so may have been due to the fact that the insufficient number of Trials in Experiment II, Series 1, did not give the looked-for effect an opportunity to appear.

Incidental to these purposes of the two experiments, an attempt was made to fit the data into the Estes and Straughan (1954) probability model which, under assumptions held to be tenable here, was seen as equivalent to the Bush and Mosteller (1955) model. The results of Experiment I appeared to be described adequately by the model. The results of Experiment II were not. Again, the reason suggested was that in Experiment II there were not enough Trials in Series 1 to achieve asymptotic responding.

CHAPTER IX

SUMMARY

Two experiments were performed to test the extension of Miller and Dollard's (1941) formulation of instrumental conditioning as the process underlying the acquisition of imitative behavior.

In Experiment I, three levels each of the rate of pressure to imitate (PTI) and of reinforcement of imitation (ROI) were varied factorially among nine groups of eight _Ss_ each.

The _Ss_, drawn from introductory Psychology courses at the University of Florida, were to predict on each of 189 Trials which of three lights would be correct. A modified Crutchfield apparatus made it possible to present the "predictions" of two dummy _Ss_ (D_1 and D_2) to _Ss_ in individual booths before the latter made their predictions. Each light was correct in random sequences on .33 proportion of Trials.

PTI was produced by preassigning the same "prediction" to D_1 and D_2. ROI consisted of indicating that D_1's "prediction" was correct. For different groups, ROI and PTI occurred randomly on .00, .33, or .67 proportion of Trials. The proportions, in Blocks of 27 Trials, of _Ss_' responses in agreement with D_1, D_2, or $D_{1\&2}$ were the dependent variables.

Imitative responses were shown to give rise to typical probability learning curves, approaching asymptotes at the probability levels of ROI, but influenced by the PTI level. By a χ^2 goodness-of-fit

criterion, the fit was an adequate one overall (χ^2=351.92, df=161, p>.05).

The significant *F*-ratios for D_1-responses (ROI: *F*=76.64, p<.001, df=2; ROI x PTI: *F*=3.06, p<.025, df=4; Trials x ROI: *F*=9.47, p<.001, df=12) and $D_{1\&2}$-responses (ROI: *F*=49.06, p<.001, df=2; ROI x PTI: *F*=12.85, p<.001, df=4; T x ROI: *F*=6.68, p<.001, df=12) substantiate the effect of PTI. In general, the higher the PTI rates were, the higher was the level of responding for any ROI level. The significant *F*-ratios for D_2-responses (all, except the T x ROI x PTI interaction, being significant at <.05) indicate that the overall effect was one of extinction of this response.

The results of Experiment I suggested that PTI had characteristics of secondary drive and that changing the rate of PTI from its initial value should correspondingly change the rate of responding from the asymptotic level achieved under the earlier value; further, that the change should be greater for the response with the higher habit strength. Experiment II was performed to test these hypotheses.

Two levels of ROI and PTI (.33 and .67) were varied factorially among eight groups of *S*s similar to those in Experiment I. Of four groups receiving .33 ROI, two groups were given .33 PTI for a Series of five Blocks of 27 Trials. One of these two groups was continued for a second Series of five Blocks under .33 PTI. The other group received .67 PTI in Series 2. The two remaining groups receiving .33 ROI were started with .67 PTI in Series 1. One of the groups continued with .67 PTI while the other group received .33 PTI in Series 2. The four groups receiving .67 ROI were distributed among the four PTI combinations in the same way.

The results of Experiment II did not offer support for the two hypotheses. Changing the PTI rate did not have the differential effect that was predicted between D_1- and $D_{1\&2}$-responses. Nor did the change in PTI rates affect the level of responding consistently. Furthermore, the stochastic model failed to describe the data. The possibility was advanced that in Experiment II asymptotic levels of responding were not reached in the five Trial Blocks of Series 1, two Blocks or 54 Trials fewer than in the seven Blocks of Experiment I.

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BIOGRAPHICAL SKETCH

Pincus Gross was born in Carei Mare, Rumania, on December 15, 1924. At about three years of age, his family took him to Sevlus, Czechoslovakia. In 1934 his family immigrated to this country and settled in Brooklyn, New York.

His elementary and high school education was in Jewish parochial schools in Brooklyn. In January, 1942, he enrolled in the Evening Session of The City College of New York and continued his religious education at the Rabbi Isaac Elchanan Theological Seminary in New York City. He continued in attendance at CCNY intermittently until January, 1953. In February, 1958, he enrolled at the University of Florida and received his B.A. in January, 1959, and his M.A. in January, 1961, both in Psychology. He continued at the University of Florida working for the doctorate and instructing part time in the Department of Psychology.

In September, 1964, he went to the College of William and Mary as an Assistant Professor of Psychology and Counselor while continuing to work on his dissertation. In January, 1966, he returned to the University of Florida as an instructor in the Department of Personnel Services and began a Clinical Internship in the Department of Clinical Psychology at the J. Hillis Miller Health Center of the University of Florida in May of that year. Without interrupting his internship, which now took him to the University Counseling Center, he served as Interim Assistant Professor of Psychology in the Department of Psychology from September, 1966, until April, 1967.

Currently, he is completing his internship at the J. Hillis Miller Health Center and has accepted a position as Assistant Professor of Psychology at Georgia State College, Atlanta, Georgia, as of September, 1967.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council. and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 12, 1967

Ernest H. Cox

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